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VITAMIN C IN GASTRIC RESECTION FOR PEPTIC ULCER

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ALTHOUGH the role of vitamin C in wound healing has long been known, its behavior during and after surgical operations was not realized until 1937, when it was shown [1] that operation or injury increased greatly the need for this vitamin. This was confirmed a few year later.[2] Moreover large concentrations of ascorbic acid are mobilized in areas of injury, an observation [3] which may explain the increased needs. A second possible relationship between vitamin C and injury was suggested by its behavior in surgical shock. It was shown, for example, that large doses of vitamin C seem to have a beneficial therapeutic effect in experimental hemorrhage [4] and traumatic shock [5] even when there is no deficit. Other experiments [6] showed that animals deficient in vitamin C were less able to resist the effects of injury on the peripheral circulation. While no specific clinical data are available, the statement has been made [7] that the intravenous injection of large doses of vitamin C "produced astonishing recovery from severe postoperative shock."

The present observations were made on 2 vitamin C–deficient patients with duodenal ulcer subjected to gastric resection and add further data in support of the two relationships mentioned. The methods

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These observations were made while the author was a Fellow in Thoracic Surgery, International Institute of Education, in the Department of Surgery, Washington University School of Medicine and Barnes Hospital, St. Louis.

1. Lanman, T. H., and Ingalls, T. H.: Vitamin C Deficiency and Wound Healing: An Experimental and Clinical Study, Ann. Surg. **105**:616, 1937. Lauber, H. J.: Ueber den Vitamin C-Stoffwechsel bei chirurgischen Erkrankungen und Eingriffen, Arch. f. klin. Chir. **189**:282, 1937.

2. Bourne, G. H.: Vitamin C and Repair of Injured Tissues, Lancet **2**:661, 1942.

3. Bartlett, M. K.; Jones, C. M., and Ryan, A. E.: Vitamin C in Surgery, Ann. Surg. **111**:1, 1940; Vitamin C and Wound Healing, New England J. Med. **226**:469, 1942.

4. Stewart, C. P.; Learmonth, J. R., and Pollock, G. A.: Intravenous Ascorbic Acid in Experimental Acute Haemorrhage, Lancet **1**:818, 1941.

5. Ungar, G.: Experimental Traumatic "Shock," Lancet **1**:421, 1943.

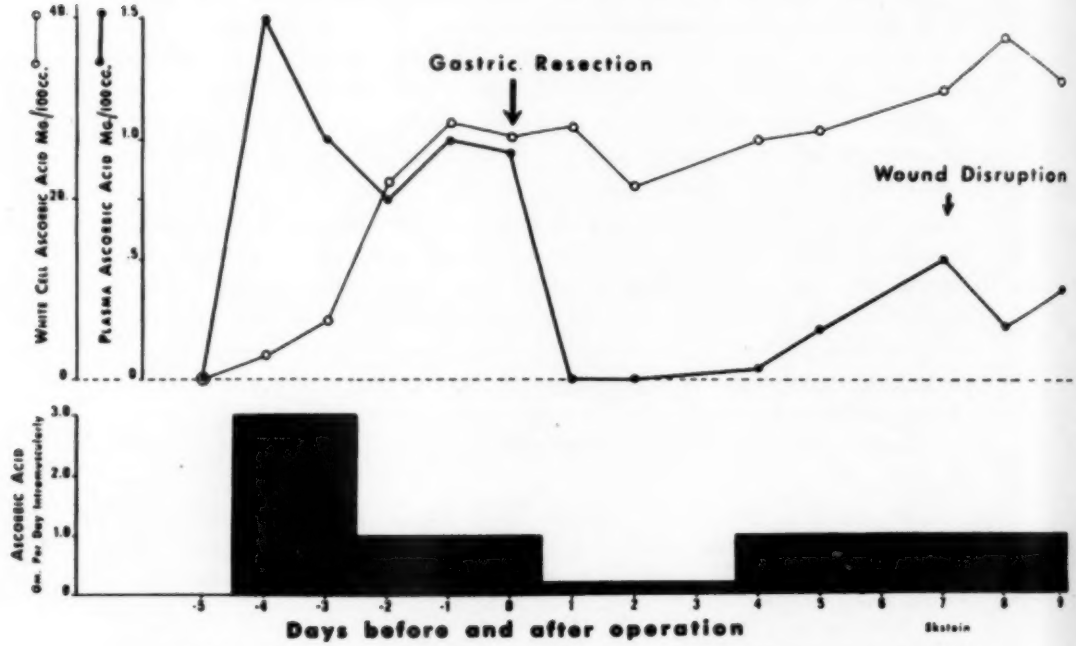
6. Schneider, E.: Erfassbare Vitaminverlust und ihre Bedeutung fur das Knochensystem, Arch. f. klin. Chir. **189**:288, 1937.

7. Holmes, H. N.: Vitamin C in War, Science **96**:384, 1942.

used in measuring vitamin C were based on the technic described by Mindlin and Butler.[8]

REPORT OF CASES

CASE 1.—B. T., a 32 year old man, had had clinical and roentgenologic evidence of duodenal ulcer of sixteen years' duration, but at the time of admission he seemed in excellent nutritional condition and routine examinations were normal. He had been on a medical regimen which was presumed to be adequate, but his diet was found later to consist largely of milk and cream, with little or no fruit juices or fresh vegetables. A preliminary determination of the level of plasma vitamin C, which showed none present, was not available before operation, so no ascorbic acid was administered. On the morning of operation the plasma



Note the absence of any vitamin C in either white cells or plasma on admission and the rapid correction in the plasma and the slower correction in white cells following large (3 Gm. daily) doses of vitamin C. Note, following operation, the prompt fall in the plasma content without a corresponding fall in white cell level. On the seventh day, after removal of the skin sutures, it was obvious that no healing had occurred, for the wound edges separated spontaneously. The rest of the wound remained intact, which was probably due to the fact that the anterior sheath of the fascia had been approximated with interrupted stainless steel sutures. Eventually the skin healed, without infection.

was again examined, including also the white cells; neither showed vitamin C. At operation a large duodenal ulcer was easily demonstrated; the ulcer and part of the stomach were resected. During the procedure, the tissue was observed

8. Mindlin, R. L., and Butler, A. M.: Determination of Ascorbic Acid in Plasma: Macromethod and Micromethod, J. Biol. Chem. **122**:673, 1938.

to be abnormally friable and capillary bleeding was unusually great. There was a progressive though moderate fall in blood pressure during the latter part of the operation. As the abdomen was being closed, however, there was a further fall in blood pressure and some depression in respiration, necessitating at one point artificial respiration. Most striking, however, was the evidence of peripheral circulatory collapse. The extremities were cold and cyanotic, and when one cut down on the peripheral veins they were found to be empty. The injection of plasma and whole blood had little influence on the peripheral circulation or on the level of the blood pressure. At a time when the patient seemed almost moribund the results of the ascorbic acid determinations became known, and because of them 2 Gm. of vitamin C was injected intravenously. Within a few minutes the blood pressure rose and soon reached normal. The color of the extremities improved, and the other evidence of circulatory impairment quickly disappeared. Large amounts of the vitamin were given during the next two days, and on the third day the level of plasma vitamin C had risen to 2.4 mg. per hundred cubic centimeters. The recovery of the patient was thereafter uneventful, and he left the hospital on the tenth postoperative day. Microscopic section of the portion of the stomach removed showed a pronounced intracellular edema not unlike that seen in scurvy.

CASE 2.—E. E., a 42 year old man, was admitted to Barnes Hospital with a history of persistent vomiting and moderate loss of weight. The present episode was one of a series during many years. A diagnosis of duodenal ulcer had been made many times in the past, on the basis of roentgenologic studies after the ingestion of a barium meal. On admission there was evidence of complete pyloric obstruction and of some bleeding, as shown by the passage of several tarry stools. A decision was made to do a gastric resection, and the patient was given preoperative preparation with transfusions, parenteral alimentation and gastric aspiration. At operation a duodenal ulcer was found, and it was resected with a large part of the stomach. Evidence of postoperative pneumonia developed within twenty-four hours but responded to chemotherapy. Removal of the sutures was followed by a gaping skin wound, which gradually filled in and healed by secondary intention. Recovery was eventually complete.

The observations on the vitamin C content of his plasma and white cells are graphically shown in the accompanying figure, the legend of which is explanatory.

COMMENT

The first case described herein was remarkable in that a total absence of vitamin C in the blood and white cells, confirmed by a microscopic appearance suggesting scurvy in excised tissue, was associated with no clinical manifestations on thorough physical and ordinary laboratory examinations. That this deficiency made the patient more susceptible to the pronounced circulatory impairment, which was observed following the gastric resection, was indicated by the prompt improvement of shock following the intravenous injection of a large dose (2 Gm.) of the vitamin. One such observation cannot be taken as more than merely suggestive; further studies would obviously seem worth while.

The second case showed that a daily dose of 200 mg. of vitamin C after operation did not prevent a total disappearance of the vitamin from

the plasma, even though the tissues had apparently been saturated thoroughly before operation. This may have occurred in the absence of complications but was presumably aggravated by the postoperative pneumonia. More significant than this was the obvious failure of wound healing, even though the concentration in the white cells remained high. This would suggest that a low or zero level of plasma ascorbic acid should not be looked on as harmless and that a sufficient amount should be given after operation in order to maintain a high plasma level. As a result of this experience at least 1 Gm. of ascorbic acid is now given as routine following gastric resection. Similar findings were observed after thoracic operations.[9] Whether such a dose is sufficient to prevent disappearance of the vitamin from the plasma after operation awaits further investigation.

SUMMARY

Two patients with duodenal ulcer were subjected to gastric resection. One, with a total, though unsuspected, absence of ascorbic acid in white cells and plasma, without clinical manifestations and uncorrected by preoperative therapy, exhibited severe surgical shock during operation, which seemed to respond promptly to the intravenous injection of 2 Gm. of the vitamin. The other, with a known absence of ascorbic acid in plasma and white cells, completely corrected before operation, exhibited after operation a fall to zero in the plasma level, with no corresponding fall in the white cell level in spite of the daily injection of 200 mg. of the vitamin; on removal of stitches on the seventh postoperative day, the wound showed no evidence of healing.

9. Zerbini, E. de J.: Importance of Ascorbic Acid (Vitamin C) in Chest Surgery, J. Thoracic Surg. **14**:309, 1945.

INCISED WOUNDS OF THE HEAD INFLICTED BY BAYONETS

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A REVIEW of recent and older medical literature discloses that the occurrence of bayonet wounds of the head is rather infrequent if not rare. I had an opportunity to observe and treat 5 patients who had penetrating craniocerebral wounds incurred with bayonets. Because of the peculiarities as well as the rarity of this type of head wound, the 5 cases are recorded herein, together with a résumé of the history of the bayonet and a review of the medical literature pertaining to such injuries.

HISTORICAL ASPECTS

Bayonet.—The infliction and treatment of incised wounds of the head from sharp-edged weapons have been of prime importance to man's existence since prehistoric times. Although in ancient times swords and spears were common implements of warfare, in more recent centuries the bayonet has taken their place and now it remains the one sharp-edged weapon of common usage by foot soldiers. The origin of the bayonet is not entirely clear. Tradition has it that the bayonet was invented near Bayonne, France, in the latter part of the sixteenth century. The story runs that the first use of the bayonet in warfare occurred in a battle between Basque peasants and a band of Spanish smugglers which took place in a small hamlet in the environs of that city in the early part of the seventeenth century; the farmers, having exhausted their ammunition, defeated their opponents by charging them with long knives fastened in the muzzles of their muskets. As Akerman [1] has pointed out, this version lacks authenticity, "and the relation begets suspicion that the mere similarity of name has laid the foundation of the supposed connection of the bayonet with Bayonne." The first use of the bayonet which historically appears to be more nearly accurate seems to have been made by the elder Puységur, a native of Bayonne, who equipped his troops for the battle of Ypres (1647) with an early model of the bayonet. He employed a steel blade fixed to a wooden haft and fitted into the barrel of the musket. The result was a plug bayonet (fig. 1).[2] From the evidence in records of court martials involving some English soldiers

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1. Akerman, J. Y.: Notes on the Origin and History of the Bayonet, Archaeologia **38** (pt. 2):422-431, 1863.

(Footnotes continued on next page)

at Tangier in 1663 and 1664, it has been established that the English had equipped their soldiers with plug bayonets. In 1671 plug bayonets were issued to a French regiment of fusiliers, and in the following year (1672) they were issued to part of an English dragoon regiment, although they were withdrawn in 1674. However, the English are known to have issued plug bayonets to the Royal Fusiliers when they were raised in 1685 and to the Foot Guards in 1686. It is said that the English defeat at Killiecrankie in 1689 was due (among other things) to the use of the plug bayonet. About the year 1678 the ring bayonet was introduced, thus allowing the use of the musket while the bayonet was attached.[3] In spite of the earlier invention of the ring bayonet it was not until about 1690 that General Mackay introduced this new type and claimed it for his own invention. In the same year, after the battle of Flurus (1690) the French tried a poorly fitting socket, or zigzag, bayonet, but Louis XIV refused to adopt it. In 1697, after the battle of Ryswick the English and Germans abolished the pike and officially introduced these bayonets, but the French did not issue them until 1783. From that time onward the bayonet became, with the musket and other firearms, the typical weapon of the infantry. Various changes in the shape and length of the blade of the ring bayonet took place in the eighteenth century, but it was not until 1805 that the spring clip device for attaching the bayonet to the gun was introduced by Sir John Moore. This device, with some modifications, is still in use. There were many changes in the blade of the bayonet from the earlier

2. (*a*) de Puységur, J.: Les memoires de Messire Jacques de Chastenet, Chevalier, Seigneur de Puységur, ed. 2, Paris, Charles-Ant. Jombert, 1747, vol. 2, p. 306. (*b*) Wintringham, T.: Story of Weapons and Tactics, from Troy to Stalingrad, Boston, Houghton Mifflin Company, 1943, pp. 114-115. (*c*) Harford, in his "English Military Discipline" (1680), observed, "The Bayonet is much of the same length as the Poniard (12 or 13 inches); it hath neither Guard nor Handle, but only a Haft of Wood Eight or Nine Inches long. The Blade is Sharp-pointed, and two edged, a foot in length, and a large inch in breadth." (Harford, R.: English Military Discipline, or, The Way and Method of Exercising Horse and Foot, According to the Practise of This Present Time; with a Treatment of all Sorts of Arms and Engines of War; of Fireworks, Ensigns, and Other Military Instruments, with Ancient and Modern. . . . , London, Privately printed, 1680, p. 13).

3. The Encyclopaedia Britannica gives credit to M. de Puységur for introducing the ring bayonet. However, Akerman states: "Puységur mentions that he had seen before the Peace of Nijmegen (1678) a regiment which was armed with swords without guards but furnished with brass rings, one at the blade and the handle, the other at the pommel." Recently Wintringham[2b] has given credit to Vauban for introducing the ring bayonet; however, he dated this as of 1687, which, of course, is later than Puységur's observation, and scrutiny of the date suggests the possibility of transposition of figures (Bayonet, in Encyclopaedia Britannica, ed. 14, New York, Encyclopaedia Britannica Company, 1937, vol. 3, pp. 242-243).

Fig. 1.—An illustration of seventeenth century sharp-edged weapons, depicting an early model of the plug bayonet (taken from Harford's "English Military Discipline," 1680).

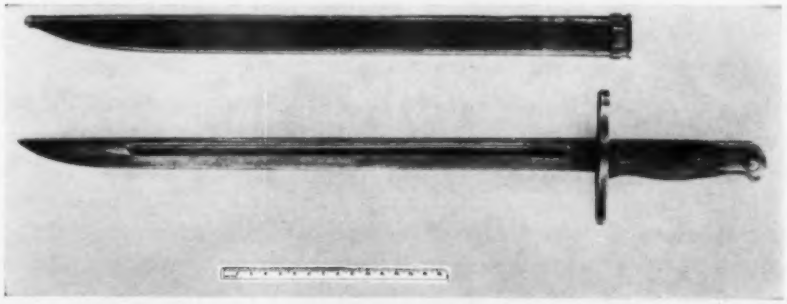

Fig. 2.—A Japanese single-edged bayonet which is triangular in cross section. The weapon is 15 inches long and weighs 15¼ ounces.

knife and dagger blade types. Among these, the triangular bayonet, so-called because the cross section of the blade had that shape, became popular, particularly with the British and Americans. Later, however, with the introduction of the magazine rifle, the British changed to the plain sword bayonet, which they used in World War I. In 1928 they changed to the 8 inch (20 cm.) pike blade. This type is cruciform in section and is no thicker than a lead pencil. In 1905 the United States forsook the triangular bayonet used in the Civil War for a 16 inch (40 cm.) blade with the front edge sharpened throughout its length and the back edge sharpened for a distance of 5 inches (12 cm.) from the point.

The German bayonet has been the same as that in use before World War I. That is, it is a sword bayonet 37.9 cm. (about 15 inches) in length and 1 pound, 4 ounces (567 Gm.) in weight. The Italian army used a dagger-shaped bayonet 11¾ inches (30 cm). long, weighing 12 ounces (340 Gm.). The French army replaced its long, cross section sword bayonet by a shorter one, with a 15¾ inch (40 cm.) blade, an action which, like the change made by the British, indicated that the utility of the bayonet in war is not so great as it was before World War I.

The Japanese have used a straight, single-edged weapon (triangular type) 15 inches (38 cm.) long and 15¼ ounces (431 Gm.) in weight (fig. 2). It is probably significant that training with the bayonet occupied a much larger portion of time in the Japanese army than in other armies.

MEDICAL HISTORY

Although military surgeons of the seventeenth and eighteenth centuries must have cared for many bayonet wounds of the head, it was not until the nineteenth century that much attention was given to cranial wounds incurred with bayonets. Hennen [4] gave such wounds prime importance in his classification of war injuries of the head. His classification was: "First, simple bayonet and spike thrust and sabre cuts; second, the same complicated with fractures; third, simple gunshot wounds and contusions without fractures; fourth, the same complicated with fractures and with lodgement of extraneous bodies."

In spite of the attention Hennen gave to bayonet wounds of the head, he noted that "perforations of bone (skull) from bayonet thrust are rare, generally fatal." From the medical history of the Crimean War, it is of interest to note that the British army suffered 11,900 casualties, but that there were only seventy-six bayonet wounds, which caused seven deaths. Even if it were assumed that the same proportion obtained among those killed (2,700), the total number of cases of bayonet wounds

4. Hennen, J.: Principles of Military Surgery, ed. 1, Philadelphia, Carey & Lea, 1830, p. 229.

would be only 93. Just how many of the bayonet wounds involved the head is not reported. Guthrie,[5] however, stated that they were rare.[6] He attributed the rarity of bayonet wounds of the head to the fact that thrusts with the bayonet were usually made toward the chest and abdomen and not toward the much less vulnerable head. Guthrie [7] further stated: "A great delusion is cherished in Great Britain on the subject of the bayonet—a sort of monomania very gratifying to the national vanity, but not quite in accordance with matter of fact. Opposing regiments when formed in line and charging with fixed bayonets, never meet and struggle hand to hand and foot to foot, and this for the very best possible reason, that one side turns round and runs away as soon as the other comes close enough to do mischief." The same might be said of present day warfare, with the difference that automatic firearms usually incapacitate those charging with fixed bayonets.

The infrequent occurrence of bayonet wounds of the head in warfare was further confirmed in the reports of casualties in the War of the Rebellion. Although two hundred and eighty-two incised wounds of the scalp were caused by sharp-edged weapons other than the bayonet, only eighteen puncture wounds of the scalp incurred by bayonets were recorded.[8] Similarly, in contrast to forty-nine incised cranial fractures, there were only five puncture-fractures of the cranium caused by bayonets. Lidell [9] (1863) further confirmed these statistics when he stated, "The truth is, that wounds inflicted by the bayonet have been of comparatively rare occurrence in every war that has scourged the earth since the invention of the weapon," the Civil War being no exception. Between the War of the Rebellion and World War I, only sporadic reports of cranial wounds caused by bayonets are found in the literature.[10]

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5. Guthrie, G. J.: Commentaries on the Surgery of the War in Portugal, Spain, France, and the Netherlands, from the Battle of Rolica in 1808, to That of Waterloo in 1815, with Additions Relating to Those in the Crimea in 1855, ed. 6, Philadelphia, J. B. Lippincott & Co., 1862, p. 38.

6. In emphasizing the infrequent occurrence of bayonet wounds of the head, Guthrie noted that the siege of Sevastopol "furnished more opportunity for such wounds but there is no record of any bayonet wound of the head."

7. Guthrie, G. J., cited by Bill,[16] p. 103.

8. Otis, G. A.: Surgical History, in The Medical and Surgical History of the War of the Rebellion (1861-65), ed. 2, Washington, D. C., Government Printing Office, 1875, vol. 2, pt. 1, chap. 1, sect. 1, pp. 1-34.

9. Lidell, J. A.: Bayonet Wounds, with Cases, Am. M. Times **7**:143, 1863.

10. Charbonnier: Perforation de la base du crâne par un coup de baionnette, Arch. de méd. et pharm. mil. **30**:195-199, 1897. Choux, C.: Contribution à l'étude des plaies pénétrantes du crâne par armes piquantes, Arch. de méd. et pharm. mil. **28**:379-395, 1896. Gaisset, A.: Deux observations de blessures produites par la bajonnett Lebel modèle 1886, ibid. **54**:16-24, 1909. Moingeard, A.: Contribution à l'étude des plaies par épéebaïonnette Lebel, ibid. **30**:396-417, 1897. It is regretted

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After the invention of automatic firearms and high explosive heavy missiles, the incidence of incised wounds of all types became even less. Among the 1,046,533 officers and enlisted men in the American Expeditionary Forces of World War I, 224,089 casualties were reported by the Medical Department, with only 235 men admitted to the hospital listed as having bayonet wounds. Of the men admitted to the hospital because of bayonet wounds, 4 died and 9 were discharged because of resulting disability.[11] Just what was the incidence of head injuries caused by bayonets is not recorded, but it seems significant that Cushing [12] did not include a single bayonet wound of the head in his reports. The British, similarly, so far as I can determine, did not report any such injuries. However, nearly all the incised wounds of the eyelids, as observed by Würdemann,[13] had been caused by bayonets, though this author failed to state the number of such injuries. Penetrating ocular wounds were rarely seen by the medical officer, according to Würdemann, partly because of the fatal nature of such wounds, for a direct bayonet thrust into the orbit resulted in deep laceration of the brain, with rapidly fatal hemorrhage. Such a casualty would therefore be included in the "killed in action" statistics. These are notoriously inaccurate as bases for accounting for causes of death.

A review of the medical literature of World War I also discloses the rarity of bayonet wounds. Although Morax and Moreau [14] reported one ocular wound caused by a bayonet, Piccoli's [15] report is the only description of a penetrating bayonet wound of the head incurred in World War I that I have found. Piccoli's patient, while engaged in hand to hand fighting in 1916, received a penetrating cranial wound caused by a bayonet which entered the left zygomatic region, causing immediate loss of consciousness. He later rallied and recovered, although hemiplegia on the right with facial anesthesia on the left side persisted,

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that the reports of bayonet wounds of the head by Ostryansky, Althoffer and Lacassagne were not available. These are: Ostryansky, A. M.: Penetrating Wounds of the Cranial, Thoracic and Abdominal Cavities, Voyenno-med. J. **225**:5-27, 1909. Althoffer, C.: Des plaies par instruments piquants et en particular par la baïonnette, Lyons, 1890. Lacassagne, A.: Des effets de la baïonnette du fusil Lebel, Lyons, 1889.

11. Love, A. G.: Medical and Casualty Statistics, in The Medical Department of the United States Army in the World War, Washington, D. C., Government Printing Office, 1925, vol. 15, pt. 2, pp. 1019, 1021 and 1022.

12. Cushing, H.: A Study of a Series of Wounds Involving the Brain and Its Enveloping Structures, Brit. J. Surg. **5**:558-684, 1917-1918.

13. Würdemann, H. V.: Injuries of the Head and Eyes in Warfare, Mil. Surgeon **49**:443-455, 1921.

14. Morax, V., and Moreau, F.: Étiologie des blessures oculaires par projectiles de guerre, Ann. d'ocul. **153**:321-332, 1916.

15. Piccoli, G.: Su di un caso raro di lesione del mesencefalo per ferita d'arma bianca, Policlinico (sez prat.) **31**:153-155, 1924.

probably due to a lesion in the cerebral peduncle and fifth cranial nerve on the left side.

Although bayonets continue to be common implements of war and were carried by troops on both sides of the conflict in World War II, they probably were not used so often as is generally thought. In the Pacific Theater, hand to hand bayonet fighting with the Japanese probably occurred more frequently than in any other theater. Of more frequent occurrence was the bayoneting of civilians in the Philippine Islands by Japanese soldiers. To my personal observation, such atrocities were not infrequent on Luzon and Cebu. Nearly all such wounds proved immediately fatal.

I, however, had the opportunity to operate on 4 patients with bayonet wounds of the head. Two of the patients were civilians, and 2 were military personnel. A fifth patient, a Filipino woman, was seen when dying, five days after she had received a penetrating wound from a bayonet in the forehead. In view of the rarity of such reports in the present century, it would seem worth while to report these cases in some detail.

REPORT OF CASES

CASE 1.—While in a foxhole at night, a 23 year old American infantryman was attacked by an enemy with a bayonet. The assailant fled on the arrival of another American soldier. By that time the victim had been severely lacerated about the head, face and upper extremities and was unconscious. He was given emergency care at a portable surgical hospital; the facial and cranial lacerations were sutured, and the upper extremities were immobilized in casts. A penetrating cerebral wound could not be débrided, because of lack of facilities and the poor condition of the patient. On the next day he was evacuated to our hospital, but he sustained the trip poorly and required supportive therapy on his arrival. Twelve hours later, with the patient under the influence of block and infiltration anesthesia produced with 1 per cent procaine hydrochloride, the left frontal wound was explored. This wound extended from the inner canthus of the right eye across the root of the nose and left side of the forehead into the left posterior frontal region, about 10 cm. above the external auditory meatus. The scalp and the frontal bone were obliquely incised in a somewhat vertical direction. The fractured surface of the frontal bone was actually smooth, giving evidence of having been incised by a sharp instrument. There was minor comminution of the inner table; the bony fragments had been driven into the brain. Linear fractures extended into the right orbit, the medial wall of the left orbit and the left parietal and preauricular regions. The orbital and cribriform plates likewise were fractured on the left, thus allowing forward tilting (elevation) of the left supraorbital section of bone. In the incised fractured area there was sufficient space through which the dural and cerebral wounds could be explored. The dura was found to be lacerated for a distance of 5 cm., through which the bayonet had almost completely amputated about 6 cm. of the tip of the left frontal lobe in the anterolateral aspect (fig. 3). A large blood clot and considerable macerated cerebral tissue were aspirated from this area, a procedure which relieved the decidedly increased intracranial pressure. After hemostasis had been obtained, the supraorbital section of bone was maneuvered back into place and the scalp was closed

in layers. Since the condition of the patient had not allowed more adequate exposure of the intracranial wound, the dura had to be left unsutured.

The postoperative course of the patient was stormy for five days, necessitating repeated performance of spinal puncture and cisternal puncture for relief of increased intracranial pressure. When these were performed, penicillin in doses of 25,000 to 50,000 units was injected into the subarachnoid and cisternal spaces. Improvement was noted after each subarachnoid drainage. There was no reaction to the penicillin. When the patient was evacuated on the eleventh day, he had been sitting up and walking a little, with assistance, for three days. His mental state was improving. There was no paralysis or aphasia.

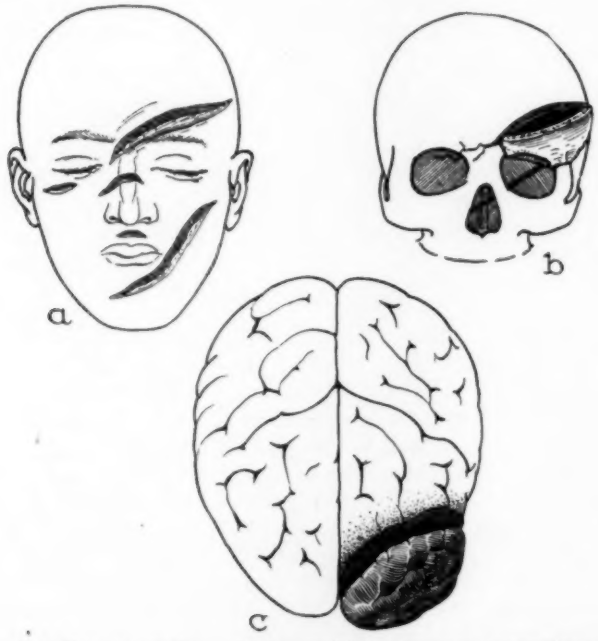

Fig. 3.—(*a*) Representation of the multiple bayonet lacerations of the face sustained by the American soldier in case 1; (*b*) the long, penetrating, incised fracture of the frontal bone incurred by a bayonet, with secondary fractures of the orbital plate, zygoma and temporal bone; (*c*) lacerated amputation of the tip of the left frontal lobe.

Case 2.—A 22 year old Filipino soldier was brought to the hospital about fourteen hours after he had received a bayonet wound in the right frontal region. He was conscious but somewhat incoherent and overactive. There was a sharply incised wound in the scalp, beginning just within the hair line near the vertex anteriorly; this wound extended somewhat downward and posteriorly to the right, terminating about 4 cm. above the pinna of the right ear. The wound was approximately 9 cm. long. After routine preoperative therapy, the wound was explored with the patient under the influence of local anesthesia, eighteen hours after injury. Débridement of the scalp and exposure of the skull disclosed a somewhat elliptic fracture of the right frontal bone, about 9 by 4 cm. in its greatest extensions. Along the posterior aspect of the wound, where the bayonet had entered, the edges of the fractured bone were typically incised, with only minor

comminution. The posterior border of the fractured elliptic section of bone was depressed about as much as the thickness of the skull. The scalp remained attached to this section of bone. There was slight comminution of the inner table along the posterior margins, with a few small indriven fragments of bone and bits of hair. These fragments of bone and bits of hair were lying in the cerebral wound. Linear fractures extended for short distances from the anterior and posterior extremities of this fracture. There was about 15 cc. of blood in the subdural space. The cerebral wound itself was smoothly incised, with minimal maceration of nerve tissue. It was about 5 cm. long and 5 cm. deep, extending into the corpus callosum in a somewhat V-shaped manner (fig. 4). Red softening of the cortex was limited, and petechial hemorrhage was minimal. The brain was moderately swollen, causing some slight tension on the dural sutures when it was closed. Penicillin, to the amount of 25,000 units in each site, was placed

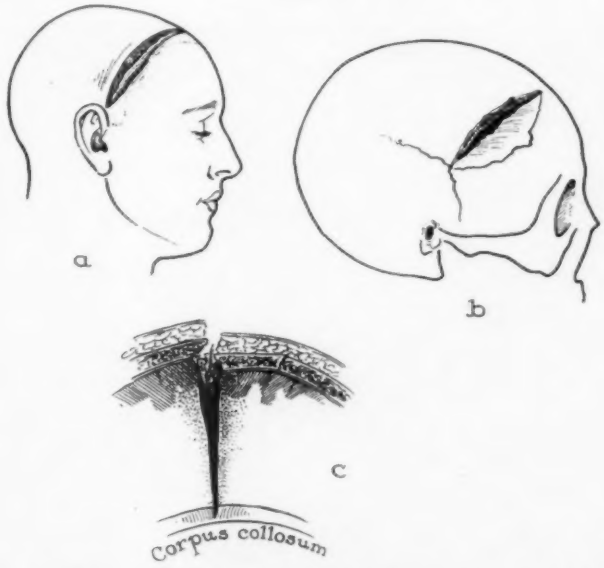

Fig. 4.—(*a*) Representation of the penetrating bayonet wound of the head sustained by the Filipino soldier in case 2, showing the scalp laceration; (*b*) the incised fracture with secondary fracture causing depression of an elliptic section of skull; (*c*) cerebral lacerations which are shown to extend down to the corpus callosum, with concomitant moderate destruction of nerve tissue.

both above and below the dura after replacement of the elliptic section of bone that had been elevated to expose the brain.

The wound healed quickly, and the postoperative course of the patient was satisfactory. Results of neurologic examination, made sixteen days after the operation, were entirely normal. A superficial psychiatric survey, however, suggested evidence of damage to the frontal lobe. The patient was evacuated to rear echelons.

Case 3.—A 16 year old Chinese girl was first examined forty-nine hours after she had been bayoneted in the left parietotemporal region. She was conscious, coherent and cooperative, although severely dehydrated. Her temperature was 104.8 F. (40.4 C.). The neurologic examination disclosed mild paresis of the right

lower side of the face and right upper extremity. Babinski's reflex was present on the right, without demonstrable change in the deep or superficial reflexes. Results of the sensory examination were not entirely satisfactory, and there appeared to be some loss of sensory function in both acuity and localization. The scalp wound was situated in a vertical direction over the postcentral region, extending from the vertex down through the pinna of the ear to a point just anterior and slightly above the external auditory meatus. The depth of the wound was directed forward in a slicing manner and was seen to extend through the skull into the brain. Roentgenograms disclosed a long oval fracture involving the anterior part of the left parietal bone and the anterosuperior portion of the squama of the left temporal bone (fig. 5). This oval or elliptic section measured approximately 9 by 4.5 cm. in its greatest extension. Its posterior edge was elevated about as much as the thickness of the skull at this point. There was

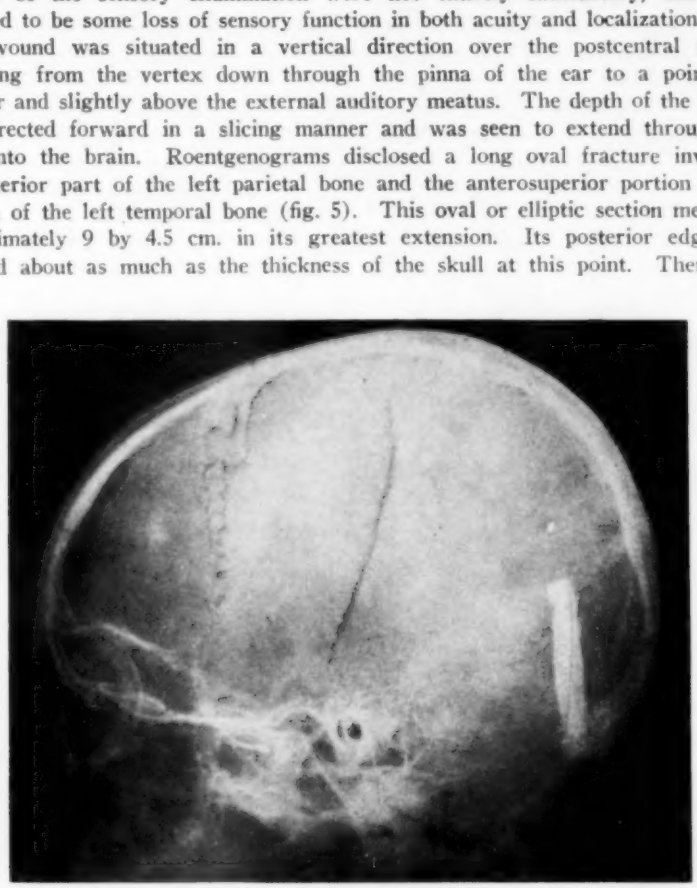

Fig. 5.—Preoperative roentgenogram of the left lateral aspect of the cranium, showing the penetrating bayonet wound sustained by the Chinese girl in case 3. An incised fracture is seen in the left parietal bone, with the lines of fracture extending into the left temporal area.

minor comminution of the inner table of the upper third of this section, with depressed, indriven fragments of bone. In addition to the head wound, there were nine severe lacerations from the bayonet in the left upper extremity.

After this patient had received plasma, whole blood, penicillin and sulfadiazine by vein, her condition improved sufficiently to permit definitive care of her wounds. The operation was performed with the patient under the influence of ether-oxygen anesthesia produced intratracheally. First, the scalp was irrigated with solution of penicillin and débrided. Then the incised fracture of the skull was exposed by a short, curvilinear incision extending from the upper angle of the wound. The elevated elliptic section of bone was further elevated and removed, because of possible infection in it and in order to obtain better exposure of the cerebral

wound. The dura mater was found to be lacerated throughout the extent of the wound. There was about 25 cc. of blood in the subdural space. The brain was acutely swollen and hyperemic, with minimal red softening and petechiae limited to the edges of the laceration. The cerebral laceration was about 3 cm. deep. It contained a small amount of blood, macerated nerve tissue and a few small fragments of bone (fig. 6). No large vessels had been severed, and there was no active bleeding. Little intracranial débridement was necessary. The dura mater was closed with interrupted black silk sutures, after which 50,000 units of penicillin was injected under the dura into the cerebral wound. After the scalp had been closed in layers, another 50,000 units of penicillin was injected beneath it. Postoperative therapy consisted in administration of sulfadiazine, penicillin and plasma and the institution of an adequate fluid and caloric intake. Spinal puncture for relief of headache was performed thirty-six hours after the operation, and 25,000 units of penicillin was injected into the spinal subarachnoid space.

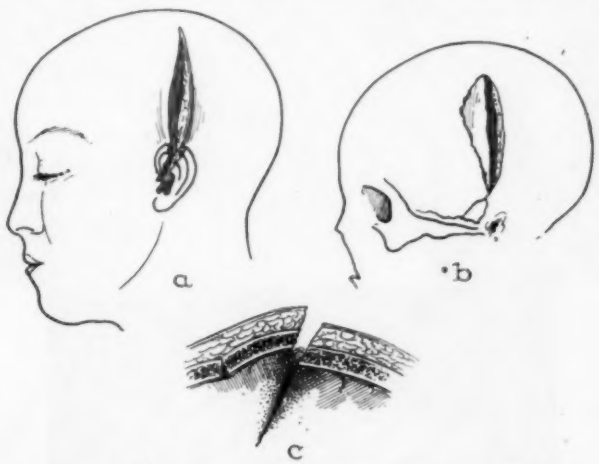

Fig. 6.—(*a*) Representation of the bayonet wound of the head in case 3, showing the linear lacerations of the scalp and ear; (*b*) the incised fracture of the skull, with extending fracture lines and elevated flap of bone; (*c*) the incised portion of meninges and brain, with minimal damage to the surrounding tissue of the brain.

The patient became conscious four hours after the operation, and when she was examined eighteen hours later she was alert, cooperative and completely oriented. The neurologic examination disclosed mild motor hemiparesis on the right side. The right upper extremity was affected more than the lower. The postoperative course was followed by uninterrupted recovery of the patient. She was ambulatory after the third day. The scalp sutures were removed on the fifth day. The patient was last examined on the twenty-first postoperative day. At that time the wound was well healed, and neurologic examination disclosed only slight facial weakness on the right, with moderate loss of sensory function in the right upper extremity and right half of the head. This was a cortical type of deficit.

Case 4.—A 14 year old Filipino boy arrived at the hospital eighteen hours after he had been struck down by a bayonet wielded by a Japanese. He had a large jagged, incised penetrating wound in the left frontoparietal region, which obviously extended deeply into the brain. His condition was poor because of shock and

hemorrhage. Neurologic examination disclosed the patient to be in a semiconscious state, from which he could be aroused to obey simple commands. There were complete hemiplegia and motor aphasia on the right side, with positive signs of involvement of the pyramidal tract on this side. After routine preoperative therapy, which included the transfusion of 500 cc. of whole blood and the intra-

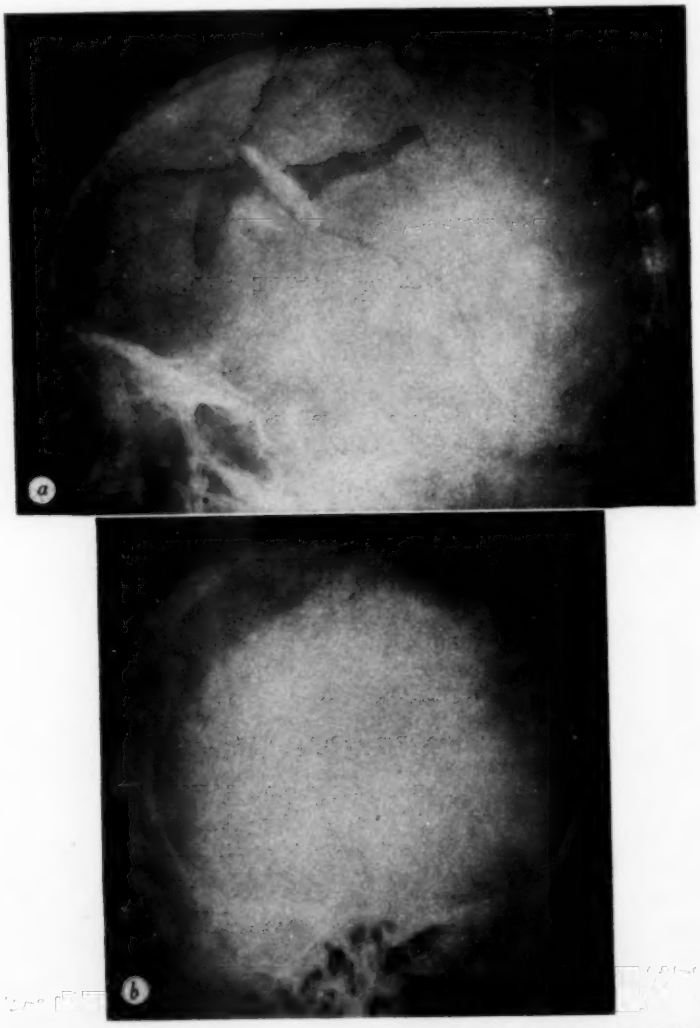

Fig. 7.—(*a*) Preoperative roentgenogram of the left lateral aspect of the cranium, showing the extensive compound, comminuted fractures in the left frontal and parietal bones sustained by the Filipino boy in case 4, with depressed indriven fragments of bone; (*b*) anteroposterior view in the same case. The excessive heat and humidity of the Philippine Islands often made it impossible to obtain better roentgenograms.

venous administration of concentrated plasma, penicillin and sulfadiazine, the condition of the patient improved sufficiently to permit surgical intervention. First, a roentgenogram was made (fig. 7). With the patient under the influence

of ether-oxygen anesthesia produced intratracheally, the wound in the scalp was débrided. While the operation was proceeding, it was found necessary to transfuse another 500 cc. of whole blood. Next, by extension of the wound by means of anterior and posterior curvilinear incisions, it was possible to reflect the scalp and to expose a large, roughly triangular, traumatic cranial defect measuring approximately 8 by 4 cm. Several large fragments of bone lay on the dura and in the cerebral wound. These were readily removed. Linear fracture lines extended from this area anteriorly across into the right frontal region, posteriorly into the left parietal bone and down into the left occipitotemporal region. The cranial traumatic defect was slightly enlarged with the rongeurs to expose adequately a lacerated portion of the dura mater about 10 cm. in length. A depressed section of the left frontal bone was easily elevated, after which the brain was explored. The cerebral wound was directed anteroposteriorly, extending from in front of area 8 (Brodmann) posteriorly into the postcentral region.

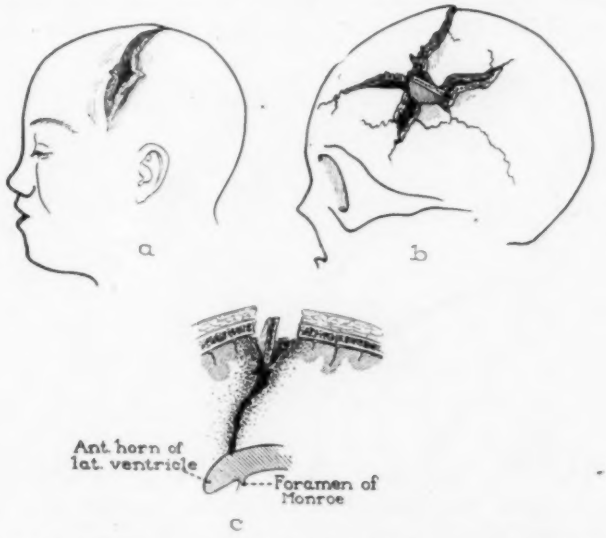

Fig. 8.—(*a*) Representation of the penetrating bayonet wound of the head concerned in case 4, showing the irregular laceration of the scalp; (*b*) extensive fracture of the skull, with indriven fragments of bone; (*c*) deep incisions and contusions of the brain, extending into the ventricle at the interventricular foramen.

Many vessels had been severed, a few of which were actively bleeding. The cerebral wound was filled with macerated nerve tissue, blood clots and fragments of bone. There was considerable red softening in the surrounding nerve tissue (fig. 8). From the appearance of the wound it was obvious that the bayonet had twisted and turned considerably after it had been thrust into the brain. When the depth of the wound was explored, it was found to extend into the anterior horn of the lateral ventricle. The floor of the ventricle was contused, as was also the tissue about the interventricular foramen. The cerebral wound was thoroughly débrided. Next, 50,000 units of penicillin sodium dissolved in 5 cc. of isotonic solution of sodium chloride was placed in the ventricle while the pulse rate, respiratory rate, blood pressure and condition of the skin were closely observed. There was no change evident in the condition of the patient. Another 50,000 units of penicillin was injected into the cerebral wound after the

dura had been closed. After this, the scalp was closed in one layer with silk sutures. Two other minor lacerations of the scalp (frontal and parietal) caused by a bayonet were débrided and sutured. By this time the condition of the patient had become extremely poor; however, after 500 cc. of whole blood had been transfused for the third time he rapidly improved, and he was taken to the ward tent in good condition.

The postoperative course for thirty-six hours was turbulent, after which the condition of the patient progressed smoothly. With the assistance of his mother, he was able to walk a few steps on the fourth postoperative day, and he was up and about daily from that time onward. Neurologic examination on the tenth postoperative day disclosed persistence of the hemiplegia on the right side and motor aphasia; a month later these symptoms were still present. Between the tenth and thirtieth postoperative day the patient was cared for in a civilian hospital. At the end of this period he was returned to the Army hospital because of an infection of the scalp wound. This wound subsequently was closed after the infection had been brought under control with penicillin and sulfadiazine.

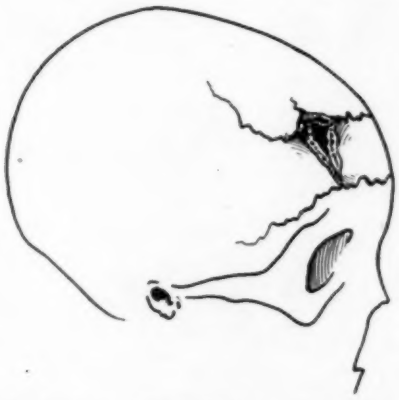

Fig. 9.—Puncture-fracture of the skull in case 5, caused by a bayonet. The wound was triangular, with linear lines of fracture extending from the angles of the triangular fracture.

Case 5.—A Filipino woman, five months pregnant, was brought to a battalion clearing station because of multiple bayonet wounds that had been inflicted by the Japanese five days previously. Examination disclosed a semicomatose woman who had, in addition to a bayonet wound of the head, some twenty-three puncture and incised wounds of the back and extremities. All the wounds were heavily infected. The wound on the right side of the forehead was situated just below the hair line and measured about 4 cm. in its vertical extension. The puncture-fracture of the skull (fig. 9) was somewhat triangular, with the base of the triangle situated at the upper end of the wound. The fracture was badly comminuted. On further examination and with the assistance of roentgenograms, linear fractures were seen to extend from the angles of the triangle. Foul-smelling, necrotic and purulent material was herniating through the wound. The patient died a few hours later, while attempts were being made to improve her poor condition by the administration of plasma, penicillin and sulfadiazine and by the transfusion of blood.

COMMENT

The type of head wound produced by a bayonet depends on the type of bayonet used and on the way the bayonet strikes the head of the victim. Ordinarily, this weapon is used with a thrust and hence produces a puncture type of wound. Slicing and tangential blows may have been the method of production of a few of the incised wounds of the scalp reported from the American Civil War. However, sabers and swords are likely to produce long linear wounds with a smooth, incised fracture of the skull. Such wounds may be inflicted by a bayonet, as occurred in the bayonet wound of the patient reported on herein in case 3. Certain wounds, sometimes called "oblique section" with "separation of an osseous flap," were commonly incurred from the saber or sword but are extremely uncommon if not rare from the thrust of a bayonet. Since the bayonet is more or less blunt, the injury is likely to be a badly con-

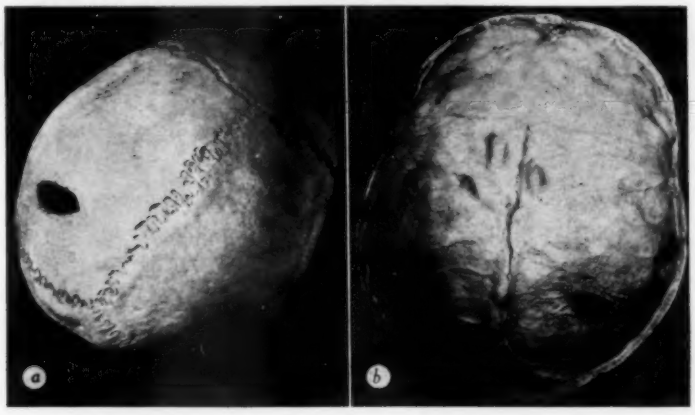

Fig. 10.—Parietal perforation on the left, consequent to a bayonet wound inflicted during the American Civil War. In *a* the external surface of the calvarium is seen; in *b* the internal surface of the calvarium is shown. The victim died of meningitis and abscess of the brain (specimen 2179, Army Medical Museum, Washington 25, D. C.; photographs by courtesy of Colonel James E. Ash, M. C., Director, Army Institute of Pathology).

tused wound. As pointed out by Bill [16] in 1882, the soft tissues about a bayonet wound usually fall together after the weapon has been withdrawn, leaving a heavily contaminated wound, for the bayonet all too commonly has been used for utilitarian purposes and therefore is nearly always soiled. The bayonet used in the American Civil War was triangular in section; it tended to make roughly triangular puncture-fractures in the cranium, with three extending branches (fig. 10). The size of the cranial wounds varied considerably, but in general all were reported

16. Bill, J. H.: Sabre and Bayonet Wounds; Arrow Wounds, in Ashhurst, J., Jr.: The International Encyclopaedia of Surgery: A Systematic Treatise on the Theory and Practice of Surgery by Authors of Various Nations, New York, William Wood & Company, 1882, vol. 2, pp. 101-118.

as small. Those of the Civil War were variously described: "The perforation in the skull barely admitted the point of the index finger," and "about an inch in length and three-fourths of an inch in breadth." [8] Small fragments of bone were commonly found depressed or indriven for varying distances into the cerebral tissue. In the reported cases the cerebral tissue frequently was found to be severely contused, although simple lacerations (incised) did occur. Laceration of the cortex, with little contusion or maceration of tissue, occurred in only 1 of the cases I have reported (case 3). In the others, there was considerable destruction of cerebral tissue, probably produced from three sources: the bayonet, fragments of bone and subsequent hemorrhage.

To judge from the reported cases, hemorrhage from both the scalp and the intracranial vessels undoubtedly was an etiologic factor in the immediate death of a victim, but for those who survived the immediate complications to be faced were purulent meningitis, encephalitis and abscess of the brain, any of which, of course, was likely to cause death within a few days. Acute purulent encephalitis and meningitis were obvious in the death of a Filipino woman in the fifth case reported herein. This patient, however, was moribund at the time she was brought to a clearing station for aid.

Rarely does one find a report of a perforating bayonet wound of the head. However, from the battle of Pultuska, Poland, in 1806, Briot [17] in 1817 described such a case. The bayonet had entered the "right temple two inches above the orbit, inclined backwards and downwards" and traversed the maxillary sinus of the opposite side, where it passed out and projected about 5 inches (12 cm.), having penetrated to the hilt. A soldier managed to extract the bayonet after a surgeon had failed. Although the victim was then left for dead, he later revived and recovered, apparently suffering only the loss of sight in the right eye!

Little need be said concerning the surgical care of bayonet wounds of the head, for the same rules of débridement, hemostasis, tight closure of the dura mater and scalp apply to the treatment of this type of wound of the head as to the treatment of any other penetrating wound of the head. When patients who have bayonet wounds of the head are brought in early for care and when sulfonamide drugs, penicillin and modern neurosurgical technics are employed, the fatality rate need not be any higher than that accompanying other types of penetrating craniocerebral injuries.

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17. Briot, P. F.: Histoire de l'état et des progrès de la chirurgie militaire en France pendant les guerres de la révolution: Ouvrage couronné par la Société médicale de Paris, Besançon, Gauthier, 1817, pp. 111-112. Briot, P. F., cited by Hennen,[4] pp. 230-231. Fardeau: Observation sur une plaie de tête faite par une bayonnett lancée par un boulet, J. gén. de méd. de chir. et de pharm. **35**:287-291, 1809 quoted by Hennen,[4] pp. 230-231.

SUMMARY

The histories and operative data concerning 4 patients who had penetrating bayonet wounds of the head have been detailed. The condition of a fifth patient, who died before operative intervention could be carried out, has been mentioned.

The literature concerning the history of the bayonet and its use in warfare has been surveyed briefly. Bayonet wounds of the head are found to be unusual. In the Surgeon General's report of the injuries incurred in the American Civil War, only 5 examples of penetrating bayonet wounds of the head are recorded, and only 1 case is recorded from World War I. The extreme infrequency of occurrence of such injuries is explained by the method of use of the bayonet, that is, a thrust action is employed which makes the abdomen and chest of the victim much more vulnerable to the weapon than the head.

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USE OF SMALL THREADED WIRES IN THE TREATMENT OF FRACTURES

I. Fractures of the Lower Extremities

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ST. LOUIS

THE SUGGESTION of some form of internal fixation as a means of fracture therapy is frequently considered as an indication that the author is a strong proponent of open reduction and internal fixation. Such is not the case in this presentation. Open reduction and skeletal fixation, whether internal or external, should not be performed in any case in which simple closed methods will suffice. The use of small

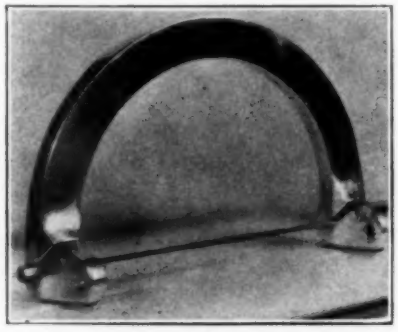

Fig. 1.—Bow used with the threaded wire for skeletal traction.

threaded wires is presented as a simple and safe adjunct to the armamentarium of the surgeon treating fractures for use in instances in which some type of internal fixation is required and for the fractures in which they are applicable. Nothing original is claimed in the basic principles of therapy involved in the types of fractures herein represented. Any procedure requiring a minimum amount of metal for fracture fixation, however, is apropos at this time, since in recent years the medical world has been bombarded with an intensive campaign of advertising for the use of massive pins and some form of external skeletal apparatus.

In the early days of leg lengthening, Crego [1] was instrumental in experimenting with various types of wires which were small in diameter,

From the Shriners' Hospital for Crippled Children and the Department of Surgery, Washington University School of Medicine.

Read before the Section on Orthopedic Surgery at the Ninety-Fifth Annual Session of the American Medical Association, July 4, 1946.

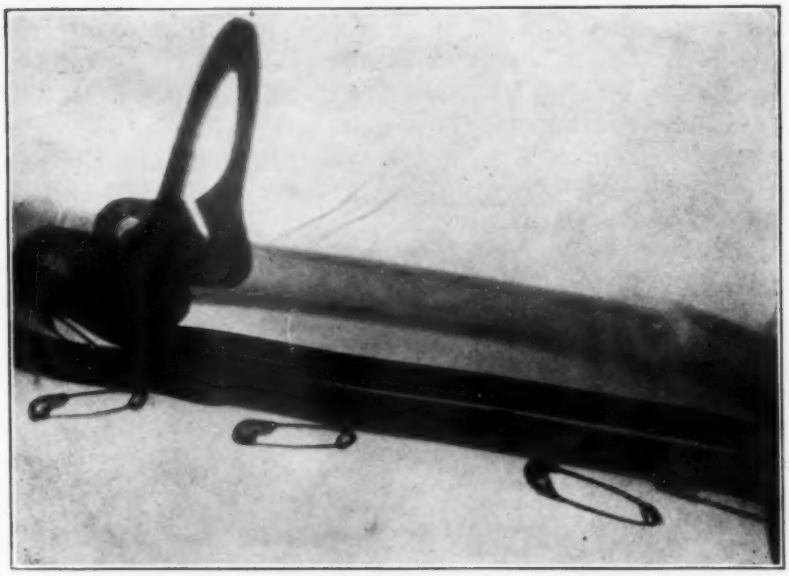

Fig. 2 (case E. L.).—Fracture of the femur of an 8 year old patient, showing the use of the traction bow and threaded wire in skeletal traction.

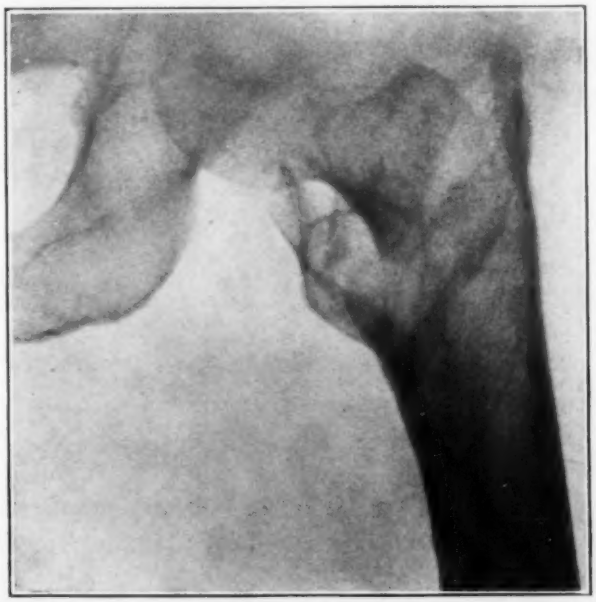

Fig. 3 (case A. E.).—A badly comminuted intertrochanteric fracture of a patient aged 50. At the time the hip was treated the comminutions were thought too numerous and too small for use of the nail plate or blade plate.

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1. Crego, C. H., Jr.: The Use of Skeletal Traction as a Preliminary Procedure in the Treatment of Early Congenital Dislocation of the Hip, J. Bone & Joint Surg. **21**:353, 1939.

yet afforded sufficient tensile strength to withstand the required load. The ordinary velocipede spoke was found to fulfil these requirements and could be easily obtained. By threading the wire throughout its length, tension in the wire could then be obtained by the use of a simple bicycle spoke nipple on each end, the nipples being tightened firmly against the bow of the leg-lengthening apparatus. Since a commercial velocipede spoke is made of plated material, some tissue reaction and discoloration resulted from their use. Wires of 18-8 stainless steel of the same diameter (0.086 inch [0.21 cm.]) were then substituted. With these no

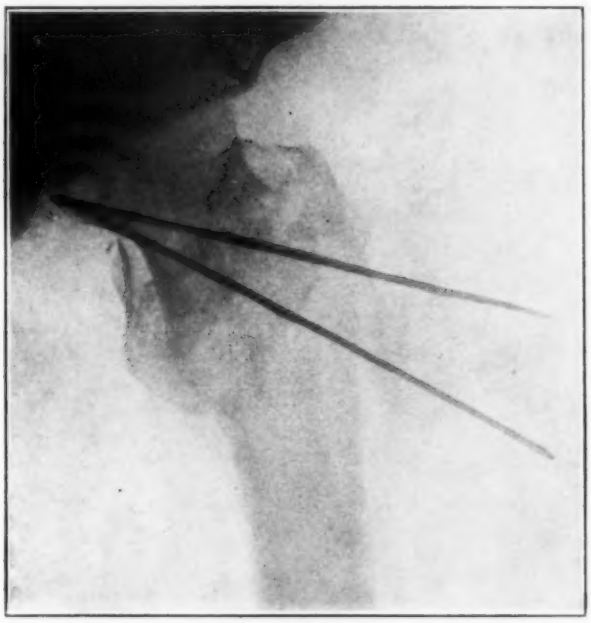

Fig. 4.—Result after reduction of the fracture shown in figure 3, showing fixation by means of two threaded wires. Long leg plaster casts and cross bars were used for external fixation. Wires were removed at six weeks.

further tissue reaction occurred, and the leg-lengthening procedure was simplified by their use.

An attempt to apply this same principle in all cases of skeletal traction was an obvious subsequent step. The Kirschner type of wire and traction bow has always seemed objectionable: first, because the bow rested across the front of the leg below the knee and thus made it impossible to place the knee in complete extension when desired and, second, because there was invariably a tendency for lateral play of the wire through the extremity, and this resulted in some infections. By use of wires which were threaded throughout their entire length, it was soon found that the tendency to lateral shifting of the wire was corrected and

the incidence of infection was almost entirely abolished. Wires of this type and the bows from the leg-lengthening apparatus were used for ordinary skeletal traction in many cases. This bow was unsatisfactory, however, because the wire had to be drilled through the bow, and this often interfered with correct placement of the wire. After further trial and error, in which bows of many different patterns and material were used, a type (fig. 1) was found which could be slotted and added after

Fig. 5.—Satisfactory alinement and bony union ten weeks after operation (figs. 3 and 4). A blade plate or nail plate is now being used in this type of fracture.

the wire was inserted and still maintain sufficient strength to withstand the pressure to which it was subjected. This type of bow and wire has now been used over a period of ten years for skeletal traction in several hundred cases (fig. 2) and has been proved satisfactory in every respect. A 3/32 inch (0.24 cm.) wire has also been used, because it can be more easily machine threaded without twisting and breaking. Small nuts are available commercially to fit both wires and take the place of the bicycle spoke nipple.

Fig. 6 (case O. C.).—Spiral fracture of the tibia and fibula in a patient aged 56.

Fig. 7.—Fracture shown in figure 6 after attempted closed reduction and fixation in a plaster cast.

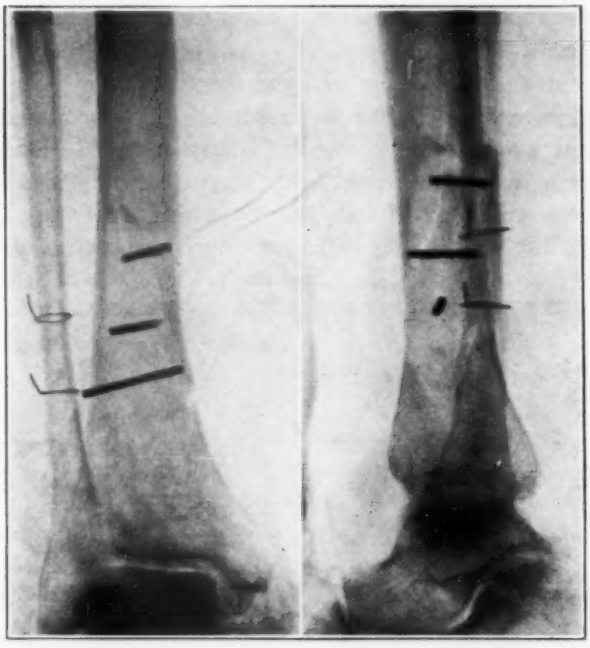

Fig. 8.—Fracture shown in figures 6 and 7 after open reduction and fixation of the tibia with three threaded wires and of the fibula with two small flexible wires.

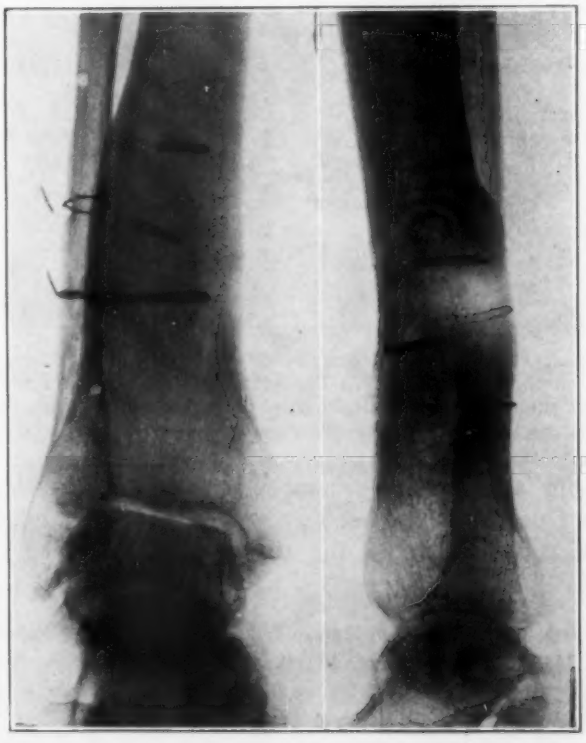

Fig. 9.—Appearance of fracture (figs. 6, 7 and 8) after fourteen months. Plaster fixation was used for four months. Solid bony union was acquired. The result was good. The wires were not removed.

In my estimation the qualities and advantages of the threaded wire made it superior to other types. It was about this time that Miller [2] reported the use of Kirschner wires in the fixation of bone grafts. If the threaded wire was superior to the smooth wire for skeletal traction, it would seem equally superior for the fixation of bone grafts or for the internal fixation of other fractures. It was tried therefore, first exactly as Miller recommended. From this beginning, their application has spread to include many types of fractures. The wires may be allowed

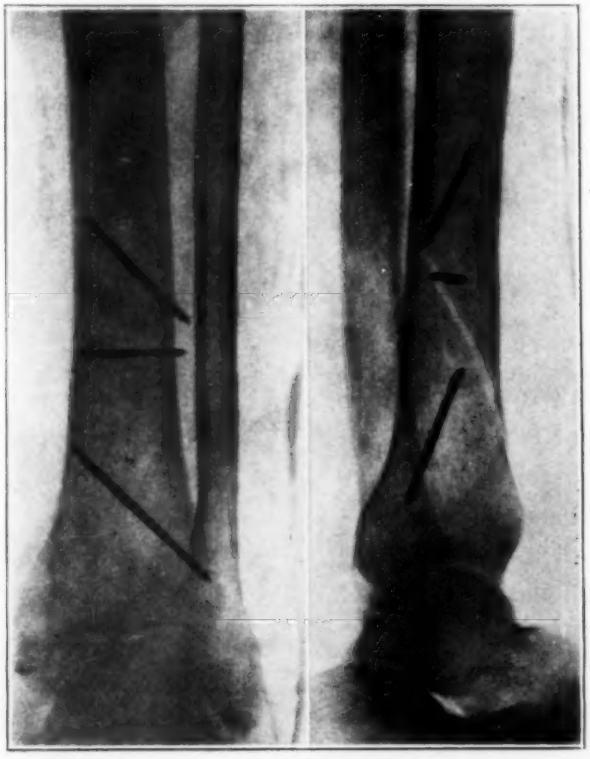

Fig. 10 (case G. B.).—Spiral fracture of the tibia with a transverse fracture of the fibula in a patient aged 47. The original roentgenogram was lost. Displacement was similar to that in figure 6. Fixation was done with three threaded wires. A plaster cast was used for three months.

to protrude for later removal or may be cut off flush with the surface of the bone and used in the same way that screws are used. With the threaded wire, no tendency for the wire to "wander" has been encountered.

2. Miller, O. L.: Simplified Internal Fixation of Inlay and Onlay Bone Grafts, J. A. M. A. **113**:635 (Aug. 19) 1939.

When the threaded wire is placed through the extremity for skeletal traction or when used in metaphysial regions of bone (cancellous) for fixation of fracture fragments, no preliminary drilling of the bone is needed. When the wire is used for fixation of heavy cortical bone, however, as in transfixing of the fragments of spiral or oblique fractures of long bones, it has been found that preliminary drilling of the wire tract is an essential step. Before this was learned an attempt was made to force the pointed threaded wire through these fragments of heavy cortical bone with a motor drill. It was found impossible to control the speed of the wire to make the rate of introduction correspond exactly to the

Fig. 11.—Solid bony union and maintenance of normal alinement three years later in case G. B. (fig. 10). The result was good. The wires were not removed. There was a slight area of rarefaction at the tip of two of the wires.

number of threads per inch (2.5 cm.) on the wire. (There are fifty-six threads to the inch, which would have meant only fifty-six revolutions for each inch of passage for the wire. With dense bone and a motor drill, this was an impossibility.) The wire in these instances reamed out a hole of equal diameter through the bone and did not cut threads in the bone. The result was inadequate fixation and loss of position of the fracture fragments in some instances.

In cortical bone, preliminary drilling with an 0.070 inch drill point (no. 50 of the standard drill point gage) for use of the 3/32 inch

threaded wire and a 0.067 inch drill point for the 0.086 inch wire insure solid fixation. This fixation has proved to be as secure as that obtained with screws. The optimum length, so often a problem in the selection

Fig. 12 (case E. B.).—Comparative roentgenogram showing the result in a bimalleolar fracture one year after closed reduction in a patient aged 30 years. Note the nonunion in the medial malleolus and the inferior displacement in the lateral view (arrow). Compare this with figures 15 and 19.

Fig. 13 (case L. C.)—Fracture of the medial malleolus in a patient aged 30 years after manipulation, showing inability to approximate the anterior lip of the fracture in the lateral view.

of screws, is of no consideration when threaded wires are used. The wire is simply drilled in the required distance and cut off when desired. With preliminary drilling of this type, the hand drill is preferable and

is always used both for the drilling and for the insertion of the wire, and pointing of the wire is not necessary. When used without preliminary drilling, pointing of the wire is essential.

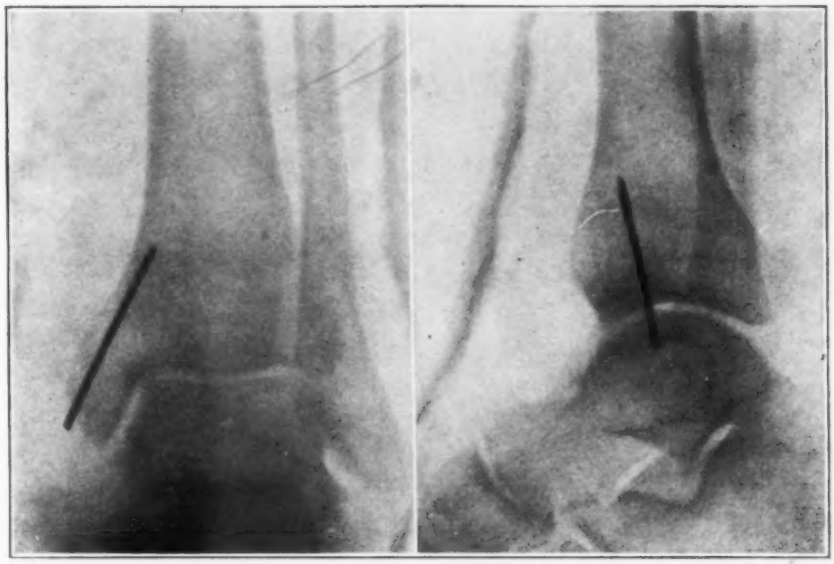

Fig. 14.—Fracture shown in figure 13 immediately after open reduction and internal fixation with one threaded wire.

Fig. 15.—Appearance in case L. C. (figs. 13 and 14) three months later, showing a normal ankle joint. The wire was not removed.

In the lower extremity, certain fractures at times require open reduction and internal fixation. In many of these, small threaded wires

have been used, and in certain types of fractures they have been found superior to other means of internal fixation. Fractures of the lower

Fig. 16 (case D. G.)—Comminuted trimalleolar fracture with posterolateral displacement in a patient aged 27.

Fig. 17.—Unsatisfactory apposition after attempted closed reduction of the fracture in figure 16.

extremity in which this means of internal fixation has been tried are as follows:

1. It has been used for comminuted intertrochanteric fractures of the femur. Prior to the widespread use of the nail plate or blade plate

Fig. 18.—Roentgenogram in case D. G. (figs. 16 and 17) immediately after open reduction of both malleoli, showing the threaded wire for the medial malleolus protruding through the skin for later removal. Flexible wire was used for the fibula.

Fig. 19.—Roentgenogram in case D. G. (figs. 16, 17 and 18), showing appearance of the ankle eight months later. The threaded wire was removed at four weeks. A plaster cast was used for four weeks and a walking plaster for four weeks. Totai fixation was done in eight weeks.

for fixation of these fractures, many attempts were made to obtain some improved means of fixation for these fractures and decrease the

long period of immobilization. With this in mind, the threaded wires were used in several instances. The fracture in 1 such case is shown in figures 3, 4 and 5. After excellent nail plates and blade plates

Fig. 20 (case D. G.).—*A*, bimalleolar fracture in a patient aged 38 years after initial manipulation by a local physician. This was an eversion fracture with lateral displacement in the beginning. *B*, unsatisfactory apposition of the medial malleolus after the second manipulation.

Fig. 21.—The fracture in case D. G. (fig. 20) immediately after open reduction and fixation of the medial malleolous only with two crossed threaded wires.

became available they were found to afford better fixation and the use of threaded wires for this type of fracture was discontinued.

2. It has been utilized for spiral or oblique fractures of the long bones. For fractures of the tibia and fibula, threaded wires afford excellent

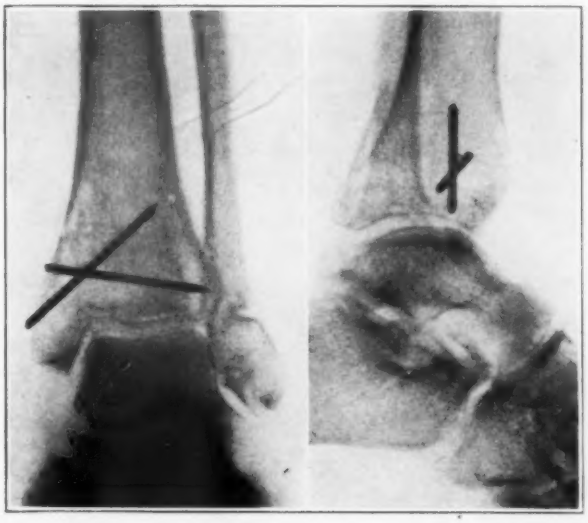

Fig. 22.—Satisfactory union and satisfactory joint contour in case D. G. (figs. 20 and 21) eight weeks after operation. The wires were not removed.

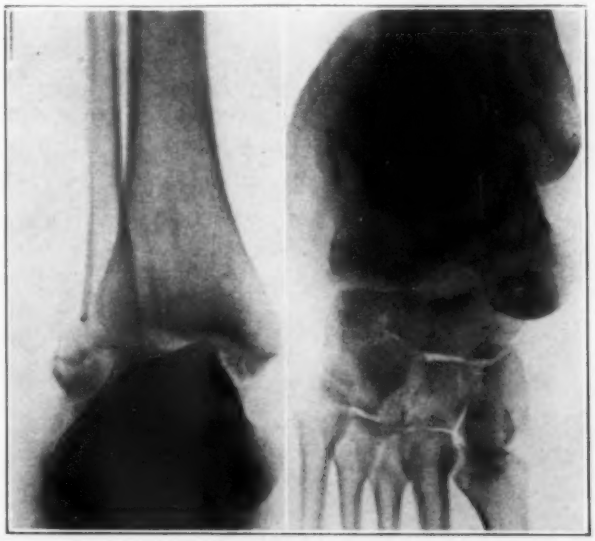

Fig. 23 (case H. M.).—Comminuted fracture of the distal end of the fibula, partial lateral dislocation of the ankle and complete dislocation of the astragalo-scaphoid joint in a patient aged 44 years.

fixation (figs. 6 to 11). It must be stressed again, however, that preliminary drilling with a drill point of smaller diameter is essential.

If an attempt is made to force the wire through heavy cortical bone with a power drill, a hole of equal diameter will be reamed out and inadequate fixation will result.

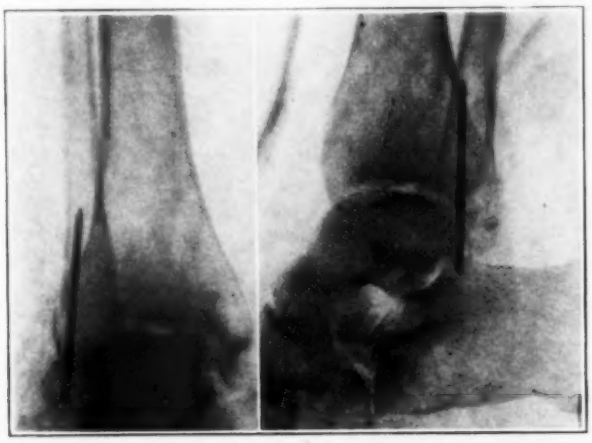

Fig. 24.—Fracture shown in figure 23 after open reduction through one lateral incision and fixation of the fibular fragments with one threaded wire. The wire was not removed.

Fig. 25.—Appearance of the fracture in case H. M. (figs. 23 and 24) after eleven months. The result was good. Motion of the ankle joint is excellent.

These wires have also been used for similar fractures of the femur and have proved entirely unsatisfactory. They will not withstand the

force and strain to which they are subjected in a fracture of the shaft of the femur. For this fracture, simple skeletal traction is far superior and is preferable, as has been pointed out by many authors previously.

3. It has been used for fractures about the ankle joint, that is, those of the medial malleolus, bimalleolar or trimalleolar with displacement (figs. 13 to 25). This probably represents the most valuable usage for the small threaded wire. Unless perfect approximation of these fragments can be obtained by closed reduction, traumatic arthritis of the ankle follows and a poor result is obtained. Nonunion of one or more fragments is not uncommon (fig. 12). The majority of fractures of this type should have open reduction, accurate replacement of fragments and internal fixation. At operation, the medial malleolus is invariably found to be separated from the shaft of the tibia by an interposed flap of periosteum and fascia which has been stripped away from the surface of the bone at the time of injury and has dropped between the fragments with their separation. Removal of this interposed soft tissue is an absolute prerequisite to anatomic replacement and reduction. Small fragments of articular cartilage are also occasionally found lying loose in the ankle joint and should be removed. Screws are too large for fixation of these small fragments and often result in their comminution. The smooth Kirschner wire does not hold as well. The threaded wire combines the desirable features of the two and is by far the most ideal.

SUMMARY

A short general discussion on the use of small threaded wires together with their use in treatment of fractures of the lower extremities is presented with roentgenographic reproductions of the procedure in representative cases. The small size of the wire, the excellent fixation afforded by the threads and the minimum amount of trauma to bone and soft tissues insured by their use render them superior to other forms of internal fixation in certain types of these fractures.

USE OF SMALL THREADED WIRES IN THE TREATMENT OF FRACTURES

II. Fractures of the Upper Extremities

H. R. McCARROLL, M.D.
ST. LOUIS

IN A PREVIOUS presentation [1] a general discussion of the development and use of the small threaded wire in the treatment of fractures was given. A repetition of that discussion does not seem necessary at this time. Although these wires were used originally in the lower extremities, their use was soon attempted in various fractures of the upper extremities, and here too they were found to be ideal in certain types. The fractures in which open reduction and internal fixation are sometimes necessary or preferable and in which the use of the small threaded wire has proved satisfactory are as follows:

1. They are used for fractures of the clavicle. In children a fracture of the clavicle seldom if ever requires open reduction. In adults, too, open reduction is seldom indicated, but an occasional case is encountered in which adequate approximation as seen in anteroposterior and oblique views is impossible. In such instances nonunion may follow. Murray [2] in 1940 described intramedullary fixation of such fractures by means of the Kirschner wire. Intramedullary fixation with a threaded wire has been used (fig. 1), the wire being drilled through the cortex, cut off flush with the surface of the bone and left in permanently. The fixation afforded by the threads prevents any tendency for the wire to wander. A sling is used for comfort and further protection for four to six weeks.

2. They are utilized for dislocation of the acromioclavicular joint. Unless adequate replacement of the clavicle and firm fixation are insured, a permanently relaxed acromioclavicular joint may result. Open reduction is easily attained through a small overlying incision, and one or two threaded wires can be drilled through the acromion and into the clavicle under direct vision (figs. 2, 3 and 4). The wires are allowed

From the Shriners' Hospital for Crippled Children and the Department of Surgery Washington University School of Medicine.

1. McCarroll, H. R.: Use of Small Threaded Wires in the Treatment of Fractures: I. Fractures of the Lower Extremities, Arch. Surg., this issue, p. 138.

2. Murray, G.: Method of Fixation for Fracture of Clavicle, J. Bone & Joint Surg. **22**:616, 1940.

to protrude for later removal. The torn capsule of the joint and overlying ligaments are then easily resutured. A Valpeau type of support is used for four weeks and a sling for four additional weeks. The wires are usually removed at six weeks.

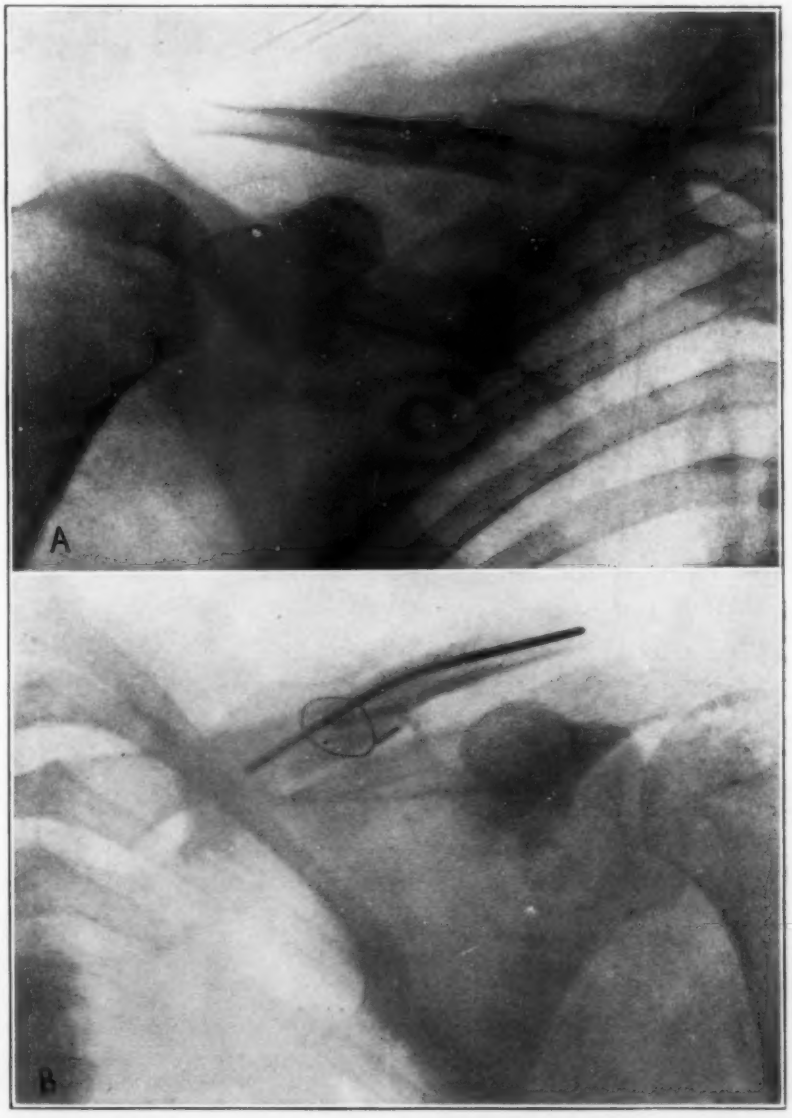

Fig. 1 (case L. M.).—*A*, fracture of the clavicle in a patient aged 53 years after application of figure of 8 bandage. The oblique view shows definite separation of fragments, the reason for open reduction. *B*, position and union ten weeks after open reduction and intramedullary threaded wire fixation. A flexible wire loop was also employed. The result was good.

3. They are used for fractures of the proximal end of the humerus. This may include a fracture of the tuberosity with displacement (fig. 5). This fragment may remain abducted or rotated by the pull of the

Fig. 2 (case F. S.).—Complete acromioclavicular separation in a patient aged 36 years.

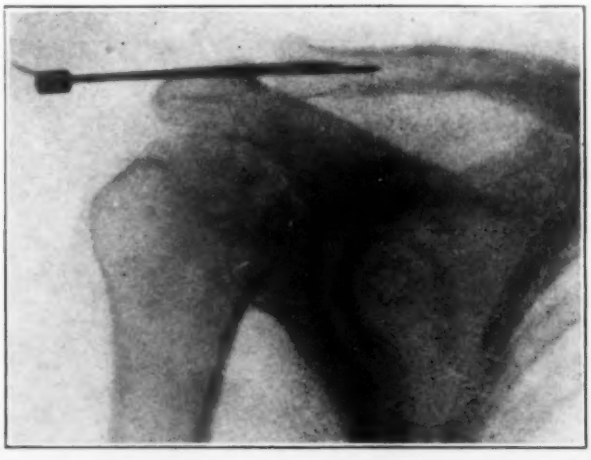

Fig. 3.—The fracture in case F. S. (fig. 2) after open reduction and fixation by means of two threaded wires, which were allowed to protrude externally.

supraspinatus tendon after attempted closed reduction or after reduction of the dislocation of the shoulder, which usually accompanies this type of fracture. In this event open reduction and adequate fixation by

means of threaded wires have proved superior to other forms of fixation. The wires are usually allowed to protrude for removal after five to six weeks. A sling is used for external support for six weeks, but exercise of the shoulder is begun extremely early.

Fractures of the surgical or anatomic neck of the humerus often become badly displaced and offer a problem, since adequate reduction is impossible unless the resulting rotation of the humeral head can be corrected. As a rule, open reduction is necessary in order to accomplish this. This is done through a small anterior incision, and adequate approximation of the two fractures is easily brought about. Reduction

Fig. 4.—Appearance in case F. S. (figs. 2 and 3) four months later. Wires were removed at six weeks. The result was good.

and proper alinement are easily maintained by the use of two threaded wires drilled through the tuberosity and into the medullary canal of the distal fragment (figs. 6, 7 and 8). These wires are always allowed to project for later removal because of possible interference with function of the joint. In figure 6 *B* the wires appear to cross the articular cartilage. This, however, is not done, as the wires pass through the tuberosity lateral and anterior to the articular margin. If there is any fear of the wire's wandering farther into the medullary canal, this can be easily prevented by the application of a nut to the projecting portion of the threaded wire (fig. 8 *B*). A hanging cast is used for six weeks, and a sling is used for two additional weeks. The projecting

wires are removed at four weeks. Pendulum exercises for the shoulder are begun during the first week.

4. They are used for fractures of the epicondyle of the humerus with displacement. These fractures usually require open reduction. The fragment is easily held firmly in place with a towel clip, and a small threaded wire drilled through the fragment and into the humerus affords

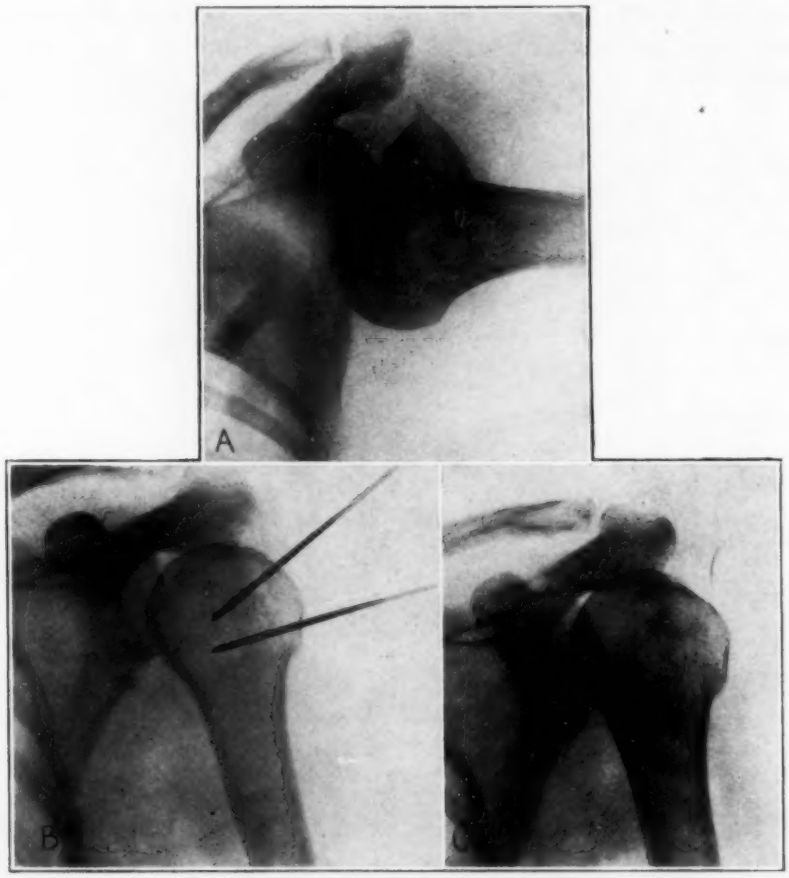

Fig. 5 (case D. D.).—*A*, fracture dislocation of the shoulder in a patient aged 38. Fluoroscopic examination after closed reduction shows the tuberosity rotated and laterally displaced. *B*, appearance two weeks after open reduction and threaded wire fixation of the tuberosity. The wires were allowed to protrude. *C*, satisfactory bony union at five weeks, when the wires were removed. The anatomic result was good. The functional result was poor, with the reason unknown.

excellent fixation. This wire is cut off flush with the surface of the epicondyle and is not removed. Plaster fixation of the extremity is also necessary for six to eight weeks.

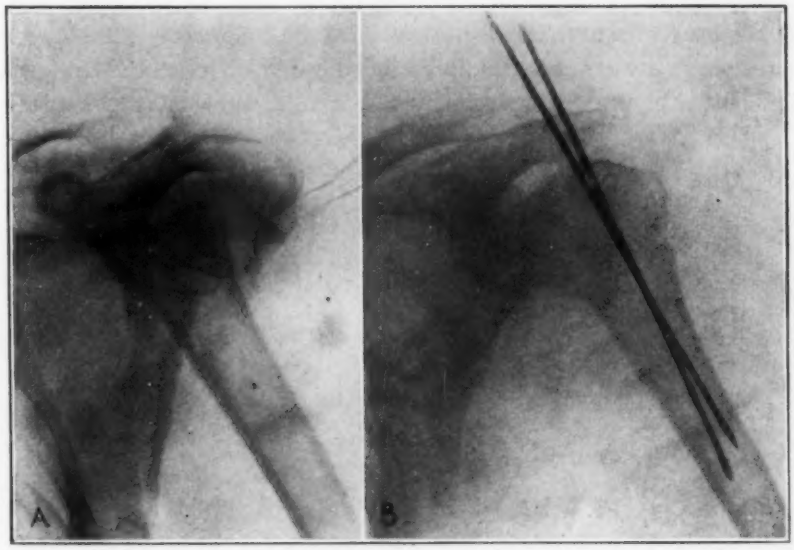

Fig. 6 (case K. G.).—*A*, fracture of the neck of the humerus, with striking displacement and with the head of the humerus rotated 90 degrees, in a patient aged 65. *B*, after open reduction and threaded wire fixation. A hanging cast was used as external fixation.

Fig. 7.—Appearance in case K. G. (fig. 6) at five months, showing complete union. The result was good. The wires were removed at four weeks.

5. They are utilized for comminuted fractures of the lower end of the humerus with extreme displacement of the fragments. Closed reduction should always be attempted in these instances, and frequently satisfactory or excellent realinement of the fragments is possible. If

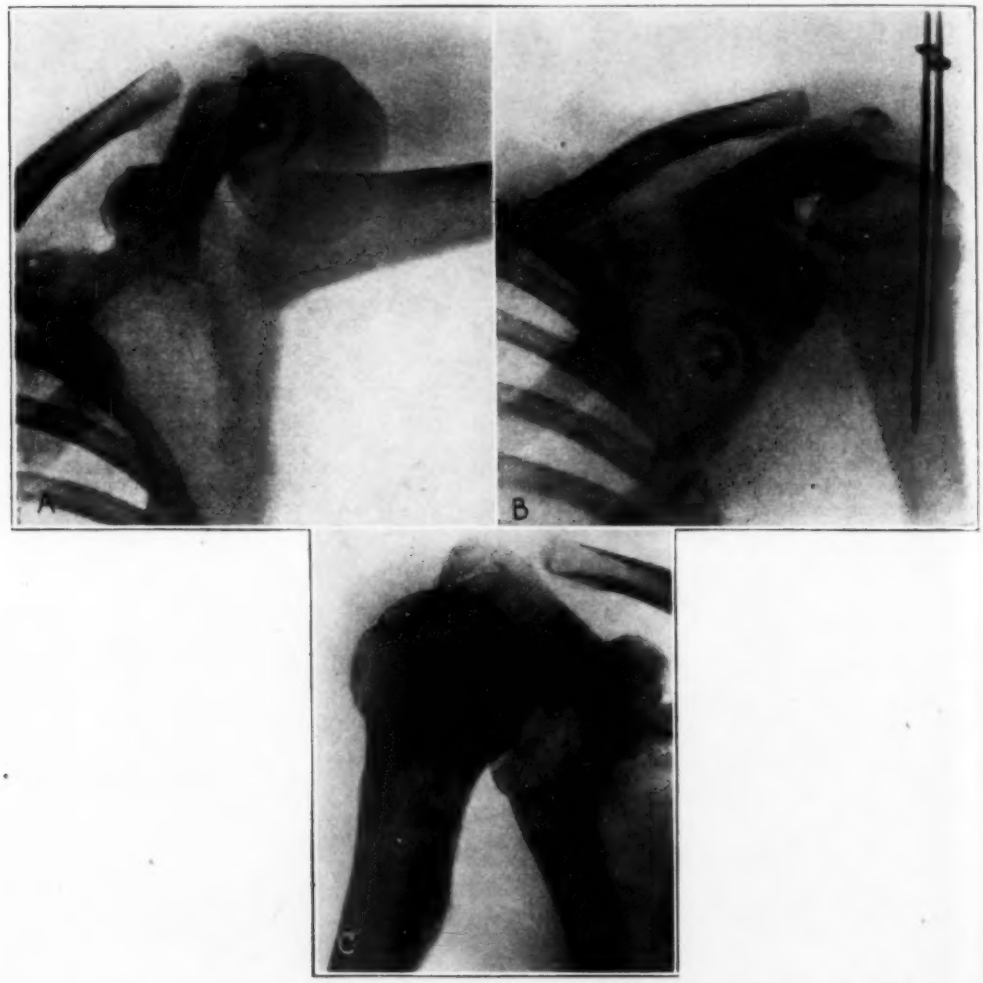

Fig. 8 (case D. W.).—*A*, complete epiphysial separation of ten days' duration in a patient aged 13. *B*, after open reduction and fixation with two threaded wires, which were removed at four weeks. A sling was used for external support. *C*, result after eight months. Normal function resulted, but the epiphysial line is closed. This may result in slight shortening, but it should be insignificant in child of this age.

satisfactory alinement is not obtained, open reduction, adequate replacement of the fragments and internal fixation are advisable. The small threaded wires have proved an excellent means of fixation. The cancel-

lous nature of the bone in this region makes their insertion with a hand drill simple and easy once apposition of the fragments has been obtained. In some instances the wires are used as screws and left

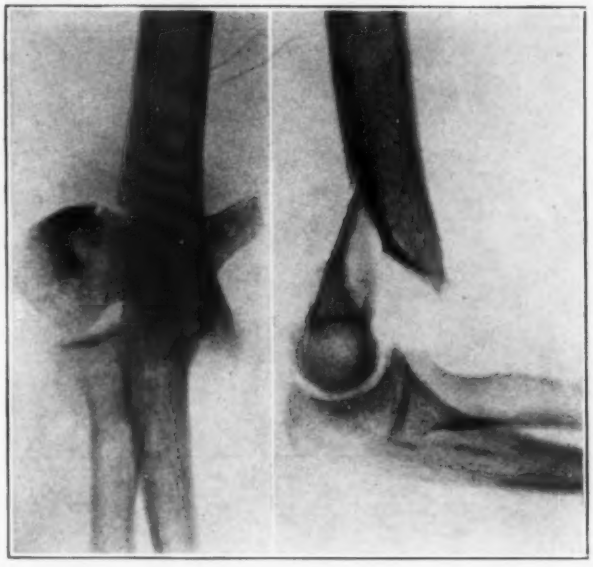

Fig. 9 (case V. H.).—Anteroposterior and lateral views, showing a comminuted supracondylar fracture in a patient aged 44 years.

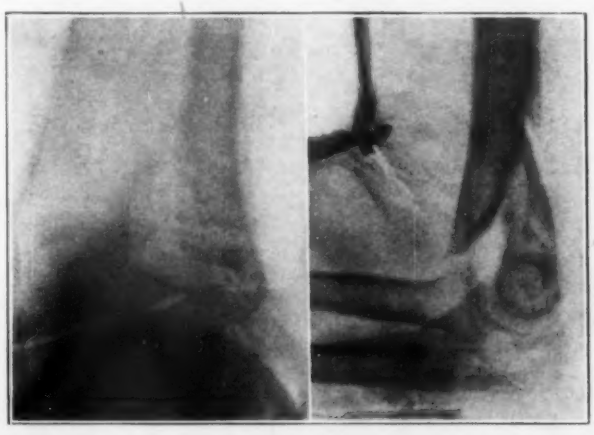

Fig. 10.—Unsatisfactory position in case V. H. (fig. 9) after attempted closed reduction.

in permanently, while in others they are allowed to protrude somewhat beyond the surface of the bone and later removed. In addition to use in the fractures shown (figs. 9 to 16), the threaded wire has been placed

transversely at times to transfix the condyles, the trochlea and the capitellum in one piece where all were comminuted and displaced in the fracture. This reconstructed fragment of the distal end of the humerus is then anchored to the adjacent portion of the shaft by means

Fig. 11.—Appearance in case V. H. (figs. 9 and 10) after open reduction and threaded wire fixation.

Fig. 12.—Appearance in case V. H. (figs. 9, 10 and 11) after one year. The functional result was fair, with motion through 60 degrees.

of a second wire inserted obliquely. Fixation by means of plaster cast is always used for sufficient time to permit union.

6. They are used for fractures of the olecranon. If such fractures are displaced, open reduction is indicated. In this way, the contour of the articular surface can be restored and the interposed periosteal flap so frequently stripped from the cortex at the time of the fracture can be

removed, thus facilitating accurate reduction and apposition of the fragments. This is done through a small overlying incision; the fragments are reduced and realined exactly as in a jigsaw puzzle and are held firmly in place with a towel clip. A threaded wire is then drilled through the fragment and into the shaft of the ulna (figs. 17, 18 and 19).

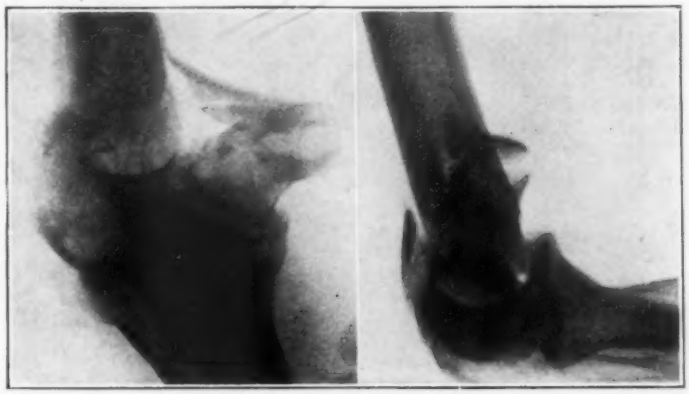

Fig. 13 (case P. G.).—Badly comminuted supracondylar fracture of the elbow in a patient aged 47 years.

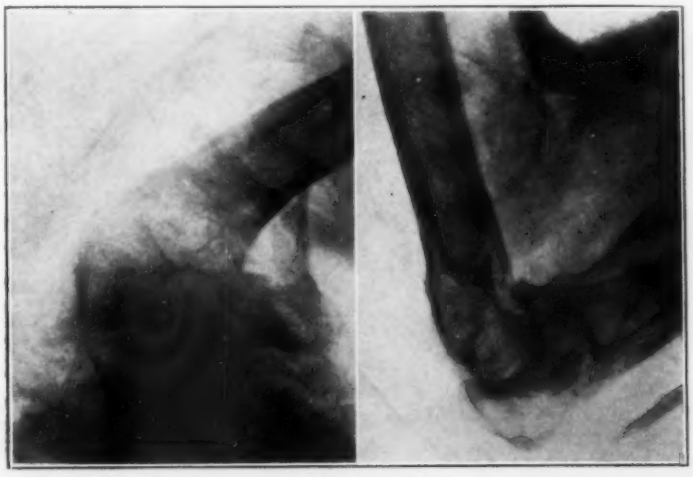

Fig. 14.—Appearance in case P. G. (fig. 13) after attempted closed reduction. The medial epicondyle and trochlea are still displaced.

The wire is cut off flush with the tip of the olecranon and is not removed. A long arm plaster cast with the elbow flexed 40 to 45 degrees is used for six weeks. This fracture ranks with the fracture of the malleoli as the most desirable for threaded wire fixation. The use of the wire loop insures neither accurate apposition of the fragments nor restitution of a

normal articular surface. A screw is too large and may result in comminution of the small fragment of the olecranon. The smooth Kirsch-

Fig. 15.—Appearance in case P. G. (figs. 13 and 14) after open reduction, realinement and fixation with one threaded wire. The wire is protruding some for later removal.

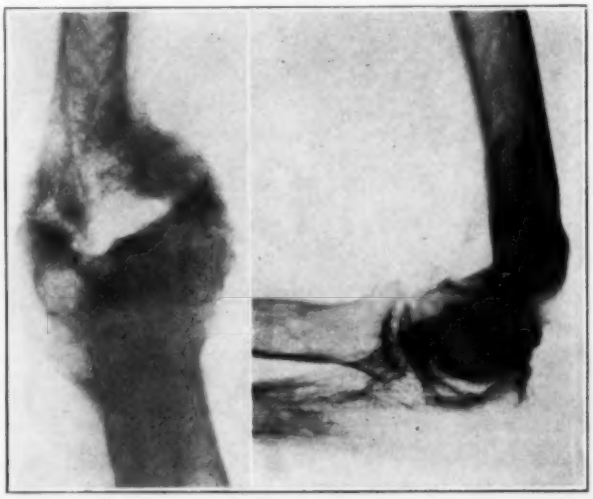

Fig. 16.—Appearance in case P. G. (figs. 13, 14 and 15) after twenty-one months. The anatomic result is good. The functional result is fair, with motion of 75 degrees.

ner wire may not hold the fragments under tension. The threaded wire combines the desirable features of all and has proved more satisfactory.

Fig. 17 (case M. E.).—Anteroposterior and lateral views, showing a comminuted fracture of the olecranon in a patient aged 70 years.

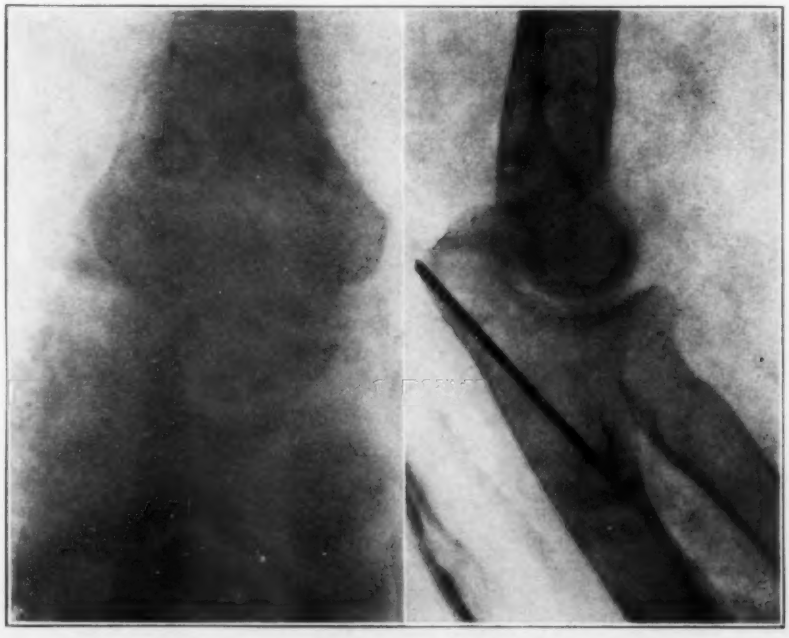

Fig. 18.—Appearance in case M. E. (fig. 17) after open reduction, threaded wire fixation and application of a plaster cast.

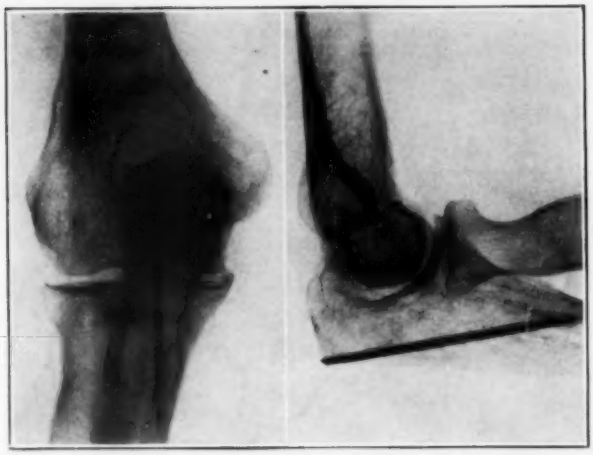

Fig. 19.—Satisfactory union and alinement in case M. E. (figs. 17 and 18) after four years. The result is good.

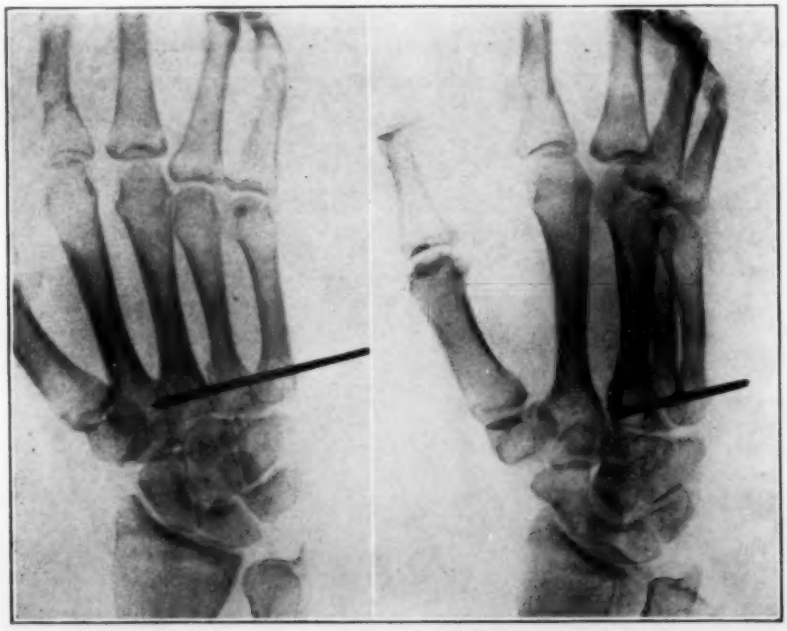

Fig. 20 (case H. S.).—Anteroposterior and oblique views of a fracture in a patient aged 19, showing threaded wire fixation for dorsal dislocation of the proximal end of the fourth and fifth metacarpals.

7. They are utilized for fractures and dislocations of the metacarpals. The threaded wire has been used successfully in these fractures. For dorsal dislocation of the proximal end of the metacarpals, fixation by the

Fig. 21 (case W. G.).—Lateral view of a fracture of the neck of the fifth metacarpal, of four weeks' duration in a patient aged 35. The result was cosmetically and functionally poor.

Fig. 22.—Appearance in case W. G. (fig. 21) after open reduction through a short lateral incision and fixation with a threaded wire drilled through the margin of the articular cartilage and into the medullary cavity. No external fixation was used.

threaded wire or some similar means is by far the most satisfactory. In order to save space as few reproductions as possible are used. Only a postreductive view of a dislocation of this type is shown (fig. 20). A second case of fracture through the neck of a metacarpal with angulation of metacarpal head to the flexor surface is shown (figs. 21, 22 and 23). In a fracture of this type the wire is passed through the distal fragment and into the medullary canal of the metacarpal, after accurate open reduction, through a small incision placed along one margin of the metacarpal involved. The wire is inserted through the distal fragment at the margin of the articular cartilage in order to disturb the structure of the joint as little as possible. In fractures of this nature the wire is always allowed to protrude, and it is removed at four weeks. No

Fig. 23.—Appearance in case W. G. (figs. 21 and 22) at six weeks. The wire was removed at four weeks. The result was good both functionally and cosmetically.

external fixation is needed, and this permits early institution of active and passive exercise in these hands, an all-important factor in preserving function.

A short discussion of the application of the threaded wire for internal fixation of certain fractures of the upper extremity is presented together with roentgenographic reproductions of treatment and results in representative cases. This is not to be considered as a plea for open reduction and internal fixation. Neither is it to be considered as a panacea for all fracture fixation. But in certain selected fractures in which open reduction is essential for the best end result, the threaded wire affords the most desirable means of fixation. The value of the threaded wire is enhanced by the minimum amount of trauma to bone and soft tissue

resulting from their use, the minimum amount of metal introduced as a foreign material and the excellent fixation afforded by the threads.

Nothing original is claimed or implied in the principles of fracture therapy demonstrated herein. The idea that wire fixation could be widely utilized for certain fractures arose from the report of Miller [3] in 1939. The wire itself was developed by Crego,[4] who, after years of application in skeletal traction and leg lengthening, first reported its use in 1939.

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3. Miller, O. L.: Simplified Internal Fixation of Inlay and Onlay Bone Grafts, J. A. M. A. **113**:635 (Aug. 19) 1939.

4. Crego, C. H., Jr.: The Use of Skeletal Traction as a Preliminary Procedure in the Treatment of Early Congenital Dislocation of the Hip, J. Bone & Joint Surg. **21**:353, 1939.

USE OF SMALL THREADED WIRES IN THE TREATMENT OF FRACTURES

III. Their Use in the Fixation of Bone Grafts

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ST. LOUIS

THE TWO preceding parts of this presentation [1] have dealt with the use of the small threaded wire in fractures of the upper and lower extremities respectively. As stated in part I, it was used first by Crego [2] in the leg-lengthening procedure and was then used in ordinary skeletal traction. Miller [3] in 1939 reported the fixation of bone grafts by means of Kirschner wires. Since the threaded wire had proved superior to the smooth wire in skeletal traction, it was an obvious assumption that it would also afford better fixation for bone grafts.

The first such application of the threaded wire was carried out exactly as recommended by Miller (figs. 1, 2 and 3), the wires being allowed to protrude for subsequent removal. The projection of a wire through the surface of the skin, however, entails some risk of infection. Too, it was soon learned that with proper application the wires held so firmly there was no need for removal and they could be cut off flush with the surface of the bone and used in exactly the same way that screws are employed.

In the earlier cases no preliminary drilling for the wire was employed. The pointed wire was forced through the cortical bone with a power drill, and, since the speed of the drill was greater than the rate of introduction for the wire, a hole of equal diameter was reamed through the bone and threads were not cut. In the wire there are fifty-six threads per inch (2.5 cm.), and the introduction of the wire 1 full inch to each fifty-six revolutions of the wire by means of the power

From the Shriners' Hospital for Crippled Children and the Department of Surgery, Washington University School of Medicine.

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1. McCarroll, H. R.: Use of Small Threaded Wires in the Treatment of Fractures: I. Fractures of the Lower Extremities, Arch. Surg., this issue, p. 138; II. Fractures of the Upper Extremities, ibid., this issue, p. 154.

2. Crego, C. H., Jr.: The Use of Skeletal Traction as a Preliminary Procedure in the Treatment of Early Congenital Dislocation of the Hip, J. Bone & Joint Surg. **21**:353, 1939.

3. Miller, O. L.: Simplified Internal Fixation of Inlay and Onlay Bone Grafts, J. A. M. A. **113**:635 (Aug. 19) 1939.

drill was an impossibility. In this way no threads were cut, and the wire in some instances would lie loose in the wire canal. Before this fact was learned, the loss of position of fracture fragments occurred in some instances (fig. 16). For the 0.086 inch (0.21 cm.) threaded wire, preliminary drilling with an 0.067 inch drill point is now used. For the 3/32 inch (0.24 cm.) wire, an 0.070 inch drill point is employed. The hand drill is used both for the drilling and for the

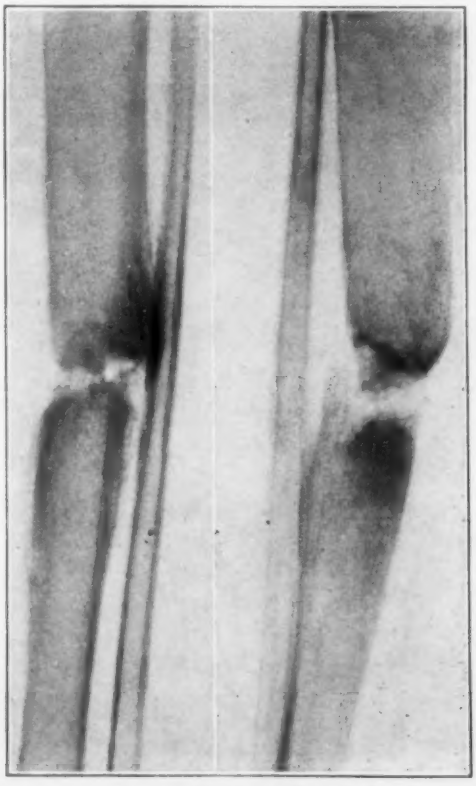


Fig. 1 (case R. P.).—Ununited fracture of the tibia of two years' duration in a patient aged 14.

insertion of the wire. In this way the wires take hold firmly, and no tendency for them to slip has been encountered. When preliminary drilling is used, the wire need not be pointed.

The wire used in this way has afforded fixation which is as firm as that obtained from standard screws. The only advantages the wire has over screw fixation is the small amount of metal required and the lack of worry about obtaining the exact length of screw required. In this method, the wire is merely drilled in the desired amount and

cut off at the surface of the bone or graft. This is not a plea that the threaded wire entirely replace screw fixation in anchorage of bone grafts. In the shaft of the femur, for instance, the stress and strain placed on the site of fracture is so great that the threaded wire should not be tried. For all other long bones, however, the fixation afforded has proved entirely satisfactory. The threaded wire, in fact, in my opinion, insures fixation equal to that of the standard metal screw.

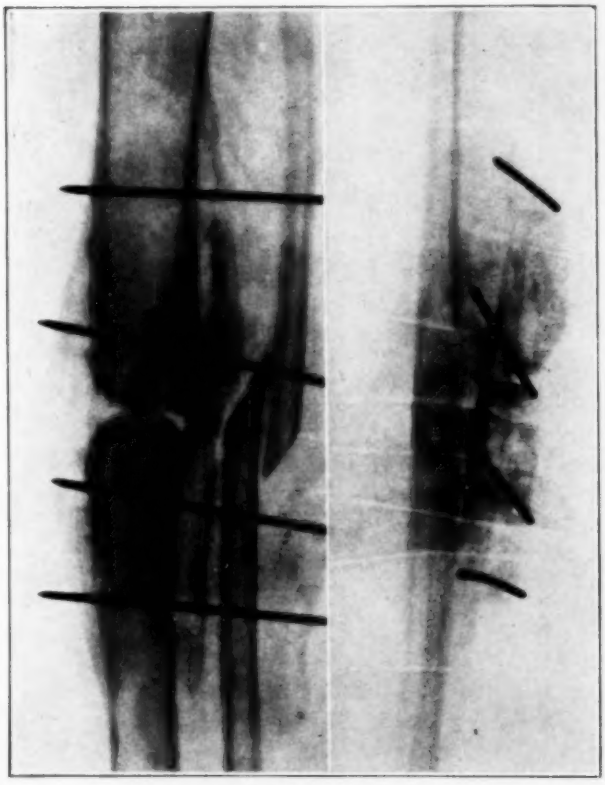


Figure 2

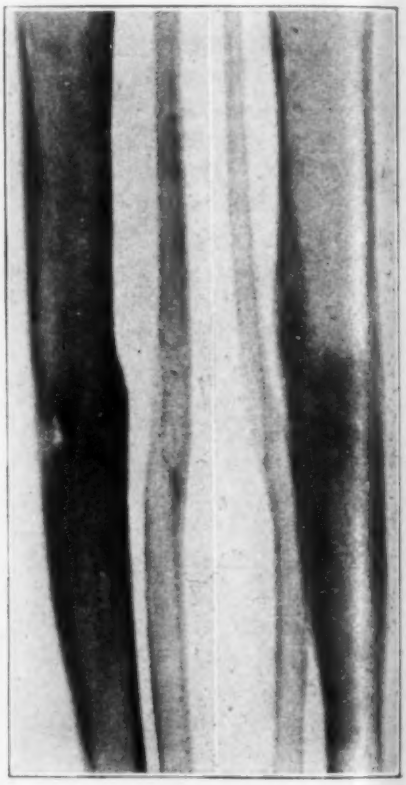


Figure 3

Fig. 2.—Appearance in case R. P. (fig. 1) while the leg was still encased in a plaster cast. A large onlay bone graft was anchored with four threaded wires, which were allowed to protrude and which were removed at ten weeks (Miller [3]). An intramedullary peg was also used.

Fig. 3.—Appearance in case R. P. (figs. 1 and 2) two years after operation.

Roentgenographic reproductions of treatment and results in representative cases show the means of fixation by the wires (figs. 4 to 17). The operative technic is identical with that of any other bone graft procedure and need not be repeated here.

SUMMARY

In part III of this presentation, the application of the small threaded wire for fixation of bone grafts is discussed. The small size of the wire, the excellent fixation afforded by the threads and the minimum amount of trauma to bone and soft tissues insured by their use render them superior to other forms of internal fixation in certain types of these fractures.

ABSTRACT OF DISCUSSION

DR. DONALD E. KING, San Francisco: Most surgeons have had the experience of seeing a Kirschner or Matthews wire wander away from its original location

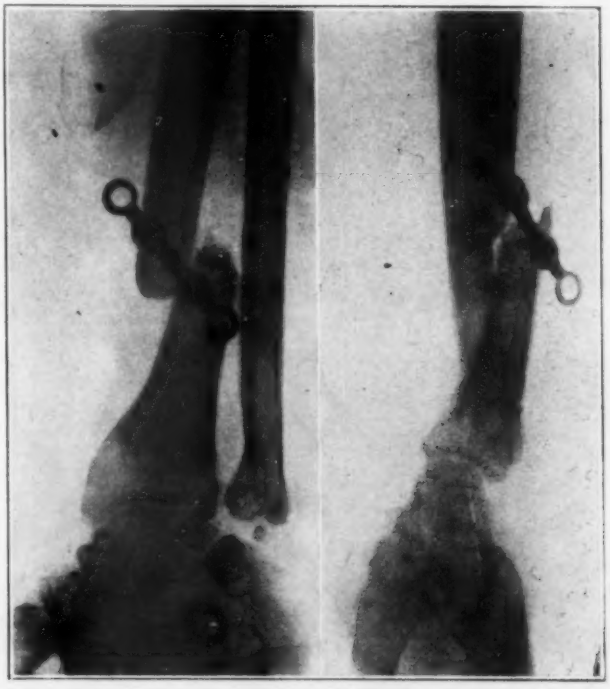


Fig. 4 (case F. G.).—Ununited fracture of the radius two months after inadequate plating in a patient aged 68 years.

into a new and dangerous position. Some years ago I removed one of these wires from the space of Retzius in a patient who had had multiple wire fixation for a fractured hip. Most of these cases are never reported in the literature.

Readers of the *Journal of Bone and Joint Surgery* will recall that in 1941 Bob Mazet reported 2 cases which were excellent illustrations. One was a case of acromioclavicular dislocation in which stiff, smooth-surfaced wires had been inserted, and the second was a case of arthrodesis of the shoulder in which stiff wires had been inserted to hold the humeral head against the glenoid. In each of the patients a wire had migrated into the chest, causing pulmonary difficulties and necessitating thoracotomy. If by using threaded wire such complications can be prevented, then it must be obvious that Dr. McCarroll's idea is a good one.

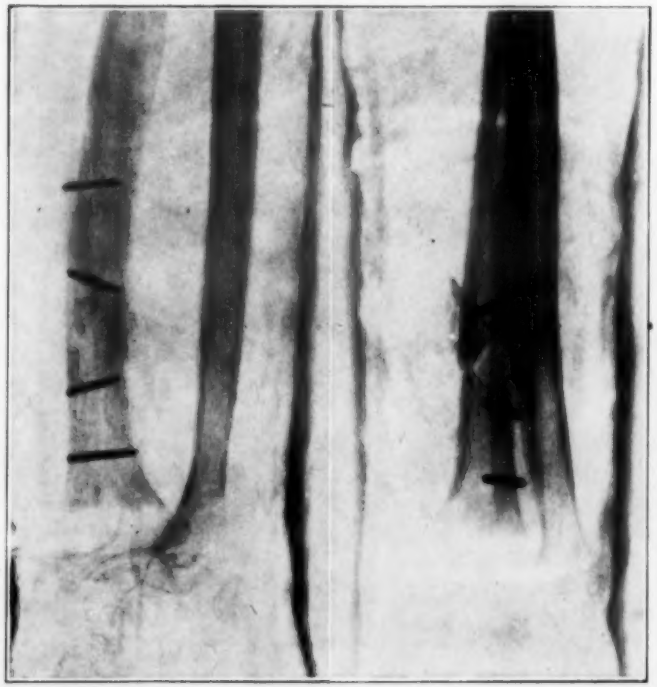
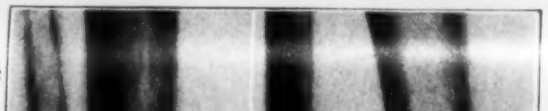


Figure 5

Figure 6

Fig. 5.—Appearance in case F. G. (fig. 4) after open reduction and application of an onlay graft fixed with four threaded wires.

Fig. 6.—Satisfactory result in case F. G. (figs. 4 and 5), with bony union six months later. Note the slight dorsal subluxation of the distal end of the ulna.



dorsal subluxation of the distal end of the ulna.

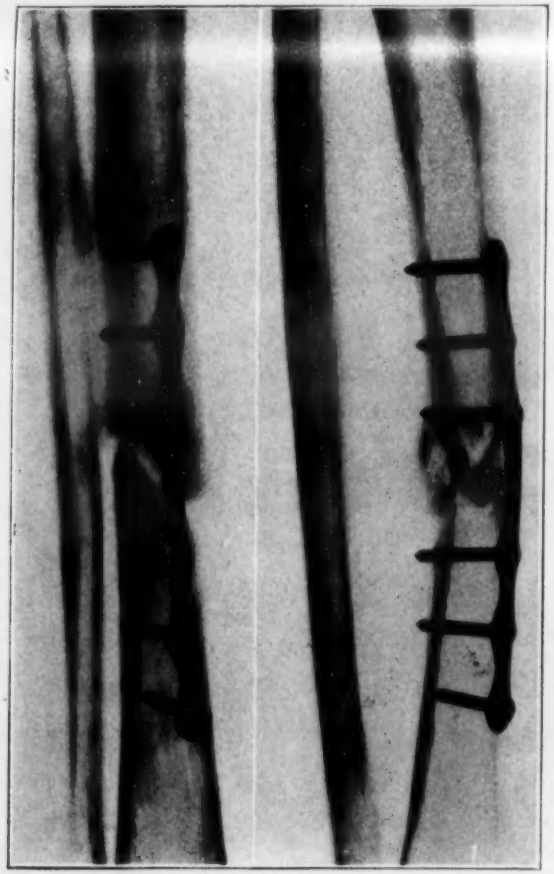


Figure 7

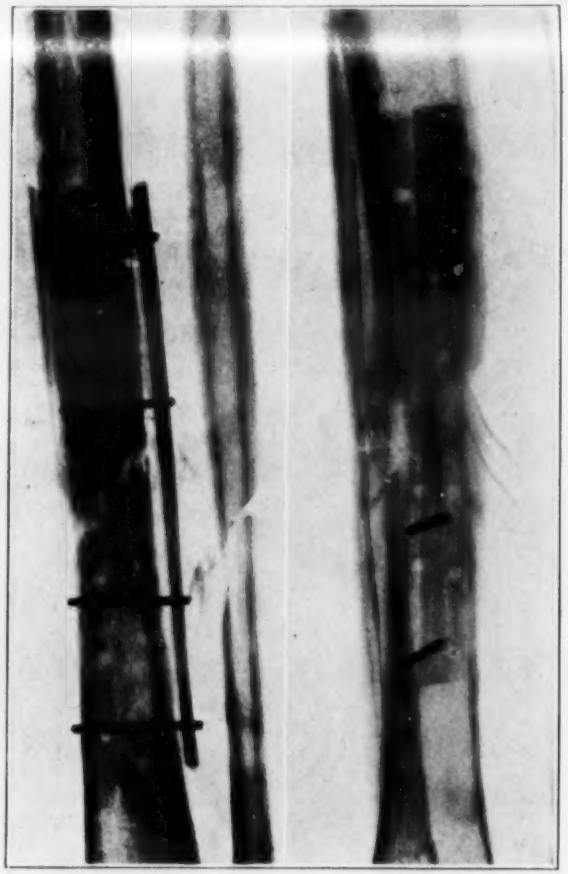


Figure 8

Fig. 7 (case J. M.).—Nonunion of an oblique fracture of the tibia six months after open reduction and application of bone plate in a patient aged 18 years.

Fig. 8.—Appearance in case J. M. (fig. 7) with the leg in a plaster cast after removal of the plate and application of a massive onlay graft anchored with four threaded wires. An intramedullary peg and three barrel stave grafts (Steele, P. B.: Barrel-Stave Grafts, in Lectures on Reconstruction Surgery, Academy of Orthopaedic Surgeons, Ann Arbor, Edwards Bros., Inc., 1944) were also used. Note the osteotomy of the fibula.

In holding a massive cortical graft I should think that screws would be much better, because the flare of the head presents a large pressure surface against the outer surface of the graft.

For a number of years I have used the smooth wire for certain fractures of the elbow joint, such as the capitellar fracture in children and the olecranon process. From now on I am going to use the threaded wire.

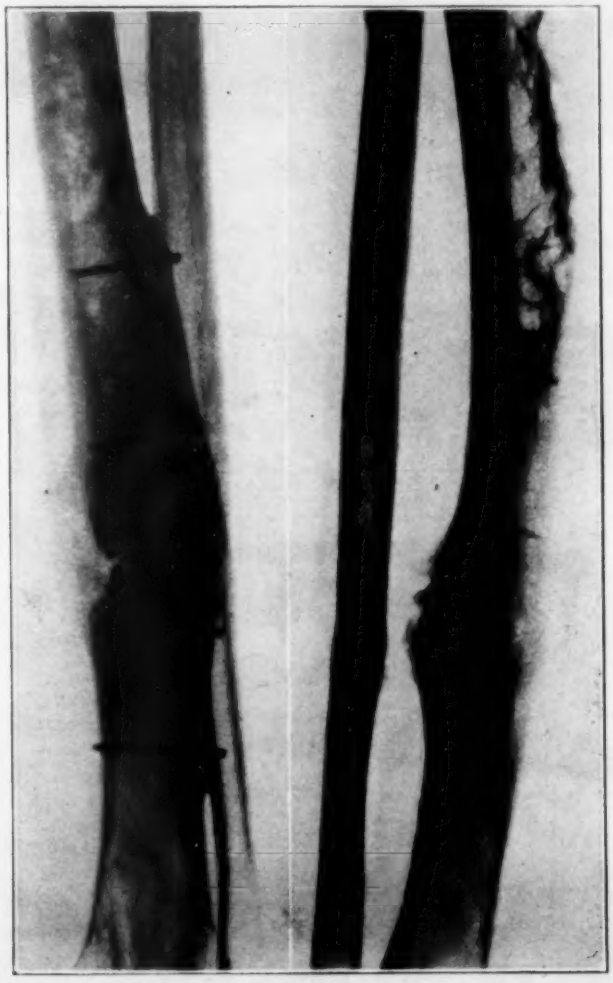


Fig. 9.—Appearance in case J. M. (figs. 7 and 8) after seventeen months. Fibrous union resulted only with a pseudarthrosis. Nevertheless the threaded wires have not changed in position, and there is no reaction around them. Multiple drilling of the pseudarthrosis has since been done.

Dr. McCarroll has pointed out that many fractures of the ankle joint require more accurate reduction and fixation and that the use of the threaded wire is the best method in this anatomic location.

Figure 10

Figure 11

Fig. 10 (case B. R.).—Ununited fracture of the ulna of one year's duration in a patient aged 19 years.

Fig. 11.—Roentgenogram in case B. R. (fig. 10) immediately after application of an onlay bone graft fixed with four threaded wires.

One sentence from the opening paragraph of his paper bears repetition: "Open reduction and skeletal fixation, whether internal or external, should not be performed in any case in which simple closed methods will suffice."

Dr. Francis M. McKeever, Los Angeles: I should like to ask Dr. McCarroll whether he has any experience with the use of the threaded wire in the

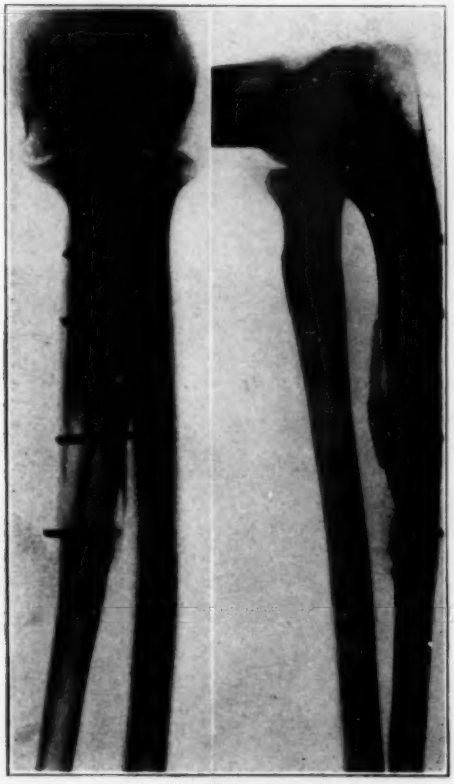


Figure 12

Figure 13

Fig. 12.—Appearance in case B. R. (figs. 10 and 11) after ten months. Solid bony union was established. The result was good, with normal function.

Fig. 13 (case H. B.).—Ununited fracture of the tibia of six months' duration in a patient aged 21 years. He was previously treated by open reduction and external fixation apparatus. Note the absorption at the end of each fragment.

treatment of fractures of the metacarpus and, if so, whether he has threaded the wire through the articular surface of the metacarpal phalangeal joints. Has it resulted in any stiffness of the joints?

I noticed in one or two of his slides that the wires had been placed through the articular cartilage, or so it looked to me.

I have nothing but commendation for Dr. McCarroll's paper, and I hope to have the opportunity to try these threaded wires. I have had no actual experience with them.

Dr. McCarroll has enumerated all the places that the threaded wire can be used with immobilized fractures and has given visual proof of the effective immobilization afforded by this small wire. Any one who has used screws has

Figure 14

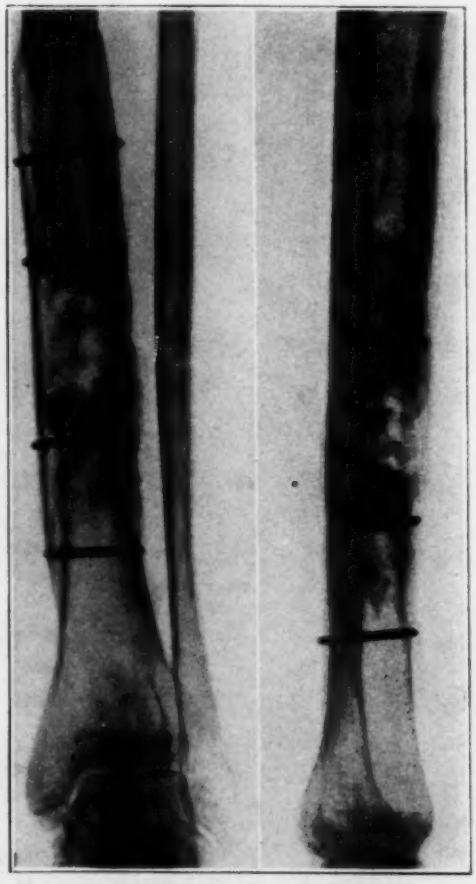


Figure 15

Fig. 14.—Roentgenogram in case H. B. (fig. 13) immediately after application of a double onlay cortical graft (Boyd, H. B.: J. Bone & Joint Surg. **23**:497, 1941) fixed with four threaded wires, transfixing the shaft and both grafts. Unsatisfactory ends of bone were resected, and the defect was packed with cancellous iliac chips.

Fig. 15.—Appearance in case H. B. (figs. 13 and 14) after eight months. Beginning of bony union seems certain. The wires have held well. The plaster cast is still being used.

run into the difficulty often encountered in getting the right length, and this must appeal to them as a useful method in internal fixation.

It appeals to me particularly for fractures of the internal malleolus of the ankle. When he fixed one of these back, I wondered whether he was encroaching on the articular space of the ankle, because such a small fragment of bone can start the screw through.

I should like to ask Dr. McCarroll whether he has used this method of immobilization in fractures of tibial tuberosities which require fixation and whether or not it works in this area. It would seem to me, without having had any

Figure 16

Figure 17

Fig. 16 (case 23).—Spiral fracture of the tibia, with the fibula fractured at a higher level in a patient aged 44 years. Open reduction and fixation were done with two threaded wires without preliminary drilling. Fixation was therefore insecure, and the fragments slipped. This shows malposition after displacement occurred. One wire had been left long for later removal. Nonunion resulted.

Fig. 17.—A second open reduction in case 23 (fig. 16) was performed two months later. A large intramedullary graft was used, being driven from above downward. Fixation was done with four threaded wires. Three barrel stave grafts (Steele) were also used. This shows the degree of union present four months after bone graft. Note the osteotomy of the fibula.

experience with the threaded wire, that in drilling its own way through the thinned-out cortex in the tibial tuberosities it might not work.

I also think that in demineralized bone, in bone grafts, possibly I would feel more secure in using a screw fixation with a flat head, which will lead to a good deal of compression.

I am sure that with the use of this little threaded wire there are many tricks in inserting it, and it is not so simple as it looks. I know that in Dr. McCarroll's hands it is probably extremely simple, and I know that he knows all the difficulties about getting it into the bone. I wish that he would mention some of these when he closes the discussion..

Dr. William J. Schnute, Chicago: In association with Dr. Edward L. Compere, I have used the threaded wires a great deal. We have found them extremely satisfactory and efficient for the multiple uses that Dr. McCarroll has discussed. In addition, we have found them valuable in fractures involving the tibial tuberosities and in fractures of the hip; only in 2 of our cases have we had any difficulty with these wires. In 1 case, a wire migrated into the pelvis and had to be removed. In a second case, one of the wires broke in the midportion of a femoral neck.

I feel that in the cases of oblique or spiral oblique fractures of the tibia transfixation screws are much more valuable than the threaded wires, because of their impacting and compression forces.

One of the most valuable uses of the threaded wires is in the internal fixation of the fractures of the neck of the femur in elderly persons, especially those who present poor risks. These threaded wires can be rapidly put into place with an automatic screw driver, without any incision being necessary and by using local infiltration anesthesia entirely. The procedure requires a total of two anterior-posterior and two lateral roentgenograms of the hip and takes about twenty to twenty-five minutes of time in the operating room.

It is important to remember that these threaded wires are used for internal fixation only and not for support.

Dr. H. H. Stryker, Kalamazoo, Mich.: My associates and I have found these wires useful in fractures of the bones of the hand and fingers. The wires inserted for fixation are cut off flush with the skin, and the skin is pulled over the end of the wire. When sufficient time has elapsed for healing of the fracture, the wire, which can be palpated beneath the skin, is removed. This lessens the danger of infection, and motion can be started earlier. In fractured metacarpals several wires are placed transversely, fixing the fractured bone parallel to the adjacent metacarpals.

Dr. H. Relton McCarroll, St. Louis: These small threaded wires must be simple if I can use them. I do not think that there is anything extremely difficult about putting them in. Their simplicity is such that no great difficulty has been encountered in their application. Preliminary drilling for these wires is not required in the cancellous portion of the bone, but the wire in such instances must be pointed. For fixation of onlay bone grafts or for fixation of any heavy cortical bone, preliminary drilling must be used; a smaller drill point is necessary for this.

As to their use in the metacarpals, the threaded wires have been used in many types of fractures that I was unable to show. They have been used in fractures and dislocations of the metacarpals and in fractures of the metatarsal bones. I have used it in 1 instance through the articular surface but prefer to place the wire alongside the articular margin if at all possible.

In regard to Dr. King's remarks, I assume that he is talking about the two fractures of the shoulder. Although they appear in the roentgenogram to have crossed the articular surface, they were entirely outside the margin of the joint. These wires were passed through the tuberosity of the humerus, anterior or lateral to the articular surface and the acromion process.

As regards fractures of the tuberosity of the tibia, none have been encountered since the use of the threaded wire was instituted, in which open reduction has seemed essential. I believe that the threaded wire would be entirely satisfactory for this type of fracture. It has been used in tibial tubercle transplants and has worked satisfactorily for that purpose.

Another point brought up is the question of the relative fixation of bone grafts. I am not advocating the use of the threaded wires for fixation of onlay grafts to the complete exclusion of screw fixation. All I can state is that in the cases in which threaded wires have been used excellent fixation has been afforded, with no loss of position in any case. In my estimation the threaded wire holds just as well as the screw.

For the average surgeon in certain selected cases, I believe that the threaded wire will be found a useful means of fracture fixation.

TREATMENT OF DEEP VENOUS THROMBOSIS WITH REFERENCE TO SUBCUTANEOUS INJECTION OF HEPARIN AND USE OF DICUMAROL

WILLIAM D. HOLDEN, M.D.
CLEVELAND

DURING the past decade the practical use of venous ligation, anesthesia of the paravertebral lumbar sympathetic system and the anticoagulants has awakened interest in the therapy of deep venous thrombosis. Prior to this period, treatment consisted in rest in bed, elevation of the extremity involved and the application of heat. There has been some confusion in the literature as to the indications for the various types of therapy that are available today. The enthusiasm of various clinics for one of the three therapeutic agents has created a considerable ambiguity in the minds of many physicians as to the benefit derived from the use of any one of them. There does not appear to be any reason for such confusion. None of the three methods, i. e.,, anticoagulant therapy, paravertebral block or venous ligation, is a panacea for venous thrombosis. The application of a few well known and well comprehended physiologic principles and clinical facts will perhaps simplify the problem.

The object in treating deep venous thrombosis of the lower extremities and pelvis is to prevent the occurrence of pulmonary emboli and to minimize the late effects of venous obstruction. It is also desirable to accomplish these ends with as little discomfort, danger and expense to the patient as is possible in attaining the foregoing objectives. To accomplish these ends, all methods of therapy should be utilized according to the indications in each patient. This attitude has been expressed before by de Takats and Fowler.[1]

PARAVERTEBRAL BLOCK

DeBakey, Burch and Ochsner[2] have shown experimentally that arteriospasm can result from the inflammation of an adjacent vein.

From the Department of Surgery, Western Reserve University School of Medicine and University Hospitals.

1. de Takats, G., and Fowler, E. F.: The Problem of Thromboembolism, Surgery **17**:153 (Feb.) 1945.

2. DeBakey, M.; Burch, G. E., and Ochsner, A.: Effect of Chemical Irritation of Venous Segment on Peripheral Pulse Volumes, Proc. Soc. Exper. Biol. & Med. **41**:585 (June) 1939.

The cold perspiring extremity with diminished temperature of the skin and reduced oscillometric index is seen in venous thrombosis. Commoner, perhaps, is the warm dry extremity with generalized vasodilation and increased amplitude of the pulse. Papper [3] has demonstrated that venospasm accompanies thrombophlebitis. Venograms performed early in the course of thrombosis of the veins in the calf often show segments of narrowing which, when correlated with the clinical observations, can best be interpreted as being due to venospasm.[4] Elevation of venous pressure is not infrequently present in the lower extremity by the time clinical manifestations of venous obstruction are apparent.[5] Both arteriospasm and venospasm associated with venous thrombosis can be abolished by paravertebral lumbar block.

VENOUS LIGATION

Ligation of the superficial and common femoral veins, the iliac veins and the vena cava has proved to be of immense value in reducing the incidence of pulmonary infarction.[6] The indications for ligating the superficial femoral veins are clear and those for the more proximal veins ambiguous. When thrombosis of the veins of the lower extremity has not extended clinically beyond the lower portion of the superficial femoral vein, ligation of that vein bilaterally just below its junction with the profunda femoral offers the best opportunity of preventing the occurrence of a pulmonary embolus. The vein is always opened before ligation to determine the presence or absence of a free thrombus. Edema of the thigh, which in its early stages can be determined only by actual measurement, and tenderness along the course of the femoral vessels should lead the surgeon to expect an attached thrombus in the femoral vein. When such clinical observations are made, thrombectomy and ligation are not attempted. The indications for ligation of the veins more proximal than the superficial femoral are not clear, and, in view of the magnitude of the operations and the too frequent occurrence of persistent edema, these operations should be performed only after more conservative measures appear to be inadequate. A patient with

3. Papper, E. M., and Imler, A., E.: The Use of Phlebography and Lumbar Sympathetic Block in the Diagnosis of Venospasm of the Lower Extremities, Surgery **15**:402 (March) 1944.

4. de Sousa Pereira, A.: The Innervation of the Veins, Surgery **19**:731 (May) 1946.

5. Ochsner, A., and DeBakey, M.: Thrombophlebitis: The Role of Vasospasm in the Production of the Clinical Manifestations, J. A. M. A. **114**:117 (Jan. 13) 1940. Tyson, M. D., and Goodlet, W. C.: Venous Pressure in Disorders of Venous System of Lower Extremities, Surgery **18**:669 (Dec.) 1945.

6. Allen, A. W.; Linton, R. R., and Donaldson, G. A.: Venous Thrombosis and Pulmonary Embolism: Further Experience with Thrombectomy and Femoral Vein Interruption, J. A. M. A. **128**:397 (June 9) 1945.

septic thrombophlebitis of the pelvic veins may require caval or iliac ligation, but in my limited experience these patients have responded satisfactorily to intensive anticoagulant and antibiotic therapy. If caval or iliac ligations are to be performed, they should be done by surgeons experienced in vascular surgery, as Homans [7] has advised.

ANTICOAGULANTS

In 1933, when Charles and Scott [8] made available for practical clinical use the anticoagulant heparin, an agent was presented that has proved to be invaluable in the therapy of venous thrombosis. Experimental evidence by Best and his associates [9] and Hedenius and Wilander [10] showed that this purified preparation of heparin had no adverse effect on the constituents of the blood or the physiologic processes of the experimental animal and the human being. It was further shown that heparin would prolong the clotting time and actually prevent thrombus formation when given intravenously in adequate amounts. It is generally accepted that heparin arrests the propagation of a thrombus in a patient with venous thrombosis. That this is of importance in minimizing the postphlebitic edema, pain, ulceration and induration has not been definitely decided. There is clinical evidence [11] to show that the incidence of pulmonary infarction is reduced by either the prophylactic or the therapeutic administration of heparin. It is also the impression of the physicians who have used heparin most extensively that the postphlebitic sequelae are minimized.

In 1944, Loewe [12] reported 15 patients who had been treated with subcutaneous administration of heparin. One hundred and twenty-five patients with thromboembolic disease treated with the heparin-Pitkin

7. Homans, J.: Medical Progress: Diseases of the Veins, New England J. Med. **235**:163 (Aug. 1) 1946.

8. Charles, A. F., and Scott, D. A.: The Preparation of Heparin, J. Biol. Chem. **102**:425 (Oct.) 1933.

9. Best, C. H.; Cowan, C., and MacLean, D. W.: Heparin and the Formation of White Thrombi, J. Physiol. **92**:20 (Feb.) 1938. Murray, D. W. G.; Jacques, L. B.; Perrett, T. S., and Best, C. H.: Heparin and the Thrombosis of Veins Following Injury, Surgery **2**:163 (Aug.) 1937.

10. Hedenius, P., and Wilander, O.: The Influence of Intravenous Injections of Heparin in Man on the Time of Coagulation, Acta med. Scandinav. **88**:443, 1936.

11. Murray, G.: Heparin in Surgical Treatment of Blood Vessels, Arch. Surg. **40**:307 (Feb.) 1940. Bauer, G.: Heparin Therapy in Acute Deep Venous Thrombosis, J. A. M. A. **131**:196 (May 18) 1946. Crafoord, C., and Jorpes, E.: Heparin as a Prophylactic Against Thrombosis, ibid. **116**:2831 (June 28) 1941.

12. Loewe, L., and Rosenblatt, P.: A New Practical Method for Subcutaneous Administration of Heparin, Am. J. M. Sc. **208**:54 (July) 1944.

menstruum were reported in 1946 by the same author.[13] (Pitkin menstruum consists of gelatin 15 to 30 per cent, dextrose 5 to 12 per cent, glacial acetic acid 0.5 per cent and sufficient distilled water to make 100 per cent.) The intravenous administration of heparin has been difficult because of the necessity of frequent determinations of the clotting time, the repeated intravenous injections and the maintenance of a constant intravenous infusion. The heparin-Pitkin menstruum, which is given subcutaneously, offers a more practical method of administration. The pain and tenderness to which most patients object following the subcutaneous injection constitute the only adverse quality of the preparation that I have encountered.

The anticoagulant dicumarol has been shown to be effective in preventing the occurrence of postoperative venous thrombosis.[14] The difficulty of regulating the dose of dicumarol has not been completely overcome, and the exact action of dicumarol in the human being is not well understood in spite of the extensive investigations concerning its effect and action in the experimental animal. The most effective level of the prothrombin clotting time is not known. The Mayo group stated the belief that it should approximate 20 per cent of normal. De Takats maintains a level between 30 and 50 per cent of normal. It is my belief that beneficial effects, i. e., cessation of the propagation of a thrombus, are realized when the prothrombin clotting time is between 30 and 50 per cent of normal. At this level, however, there is no prolongation of the actual clotting time.

Of the last 37 patients with thromboembolic disease treated at University Hospitals, 31 received heparin and dicumarol (3,3′-methylene-bis-[4-hydroxycoumarin]) subcutaneously. Of these 31 patients, 5 had ligations of the superficial femoral vein and 3 had paravertebral blocks for persistent arteriospasm in addition to the anticoagulants. Sixteen of the 31 patients had had pulmonary infarcts when the diagnosis of peripheral venous thrombosis was made. Two of the 31 patients had sublethal infarcts within forty-eight hours after the onset of anticoagulant therapy. All 31 patients recovered.

The 6 patients who did not receive anticoagulants had ligations of the femoral vein and paravertebral blocks. One of these 6 patients died six days following a bilateral ligation of the superficial femoral vein performed for a thrombosis of the veins in the calf of the left leg. Death was apparently caused by a massive pulmonary embolus, but no autopsy was obtained.

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13. Loewe, L.; Rosenblatt, P., and Hirsch, E.: Venous Thromboembolic Disease, J. A. M. A. **130**:386 (Feb. 16) 1946.

14. Barker, N. W.; Cromer, H. E.; Hurn, M., and Waugh, J. M.: The Use of Dicumarol in the Prevention of Postoperative Thrombosis and Embolism with Special Reference to Dosage and Safe Administration, Surgery **17**:207 (Feb.) 1945.

When the diagnosis of venous thrombosis is made, an evaluation of the extent and location of the thrombotic process is made. If the process is clinically confined to the popliteal and calf veins, a bilateral ligation of the superficial femoral vein is immediately performed with the patient under either local or intravenous pentothal sodium anesthesia, according to the general condition of the patient. Whether ligation is performed or not, 300 to 400 mg. of the heparin-Pitkin menstruum is given subcutaneously after the clotting time is determined and provided there is no contraindication to anticoagulant therapy. If the operation has been performed, this is given at its termination. After the prothrombin clotting time has been determined, 300 mg. of dicumarol is given. The base level of the prothrombin clotting time is especially necessary in cardiac, diabetic, malnourished and elderly patients and those recently operated on. If the initial level is below 100 per cent of normal, modified doses of dicumarol are administered. No anticoagulants are given to patients with any hemorrhagic disease or hepatic or renal insufficiency. Patients with a history of a recently bleeding peptic ulcer or patients immediately before or after parturition are not given anticoagulants.

When the anticoagulants are used, heparin should be given subcutaneously immediately. Prolongation of the clotting time is effected within one to two hours. The clotting time in my patients twenty-four hours after administration has varied between eighteen and fifty-five minutes. It is rarely over twenty minutes at the end of forty-eight hours. Clotting times are determined by the Lee-White method. To use dicumarol alone without heparin in the treatment of venous thrombosis is not justified, since the effect of the former is not apparent for forty-eight hours. It has been my experience that most of the pain in the extremities is absent or minimal within forty-eight hours after anticoagulant therapy is started. If the pain is not promptly relieved, there is no hesitation in blocking the lumbar sympathetic chain.

SUMMARY

A plan for the treatment of venous thrombosis is presented embracing the physiologic principles underlying the use of and the indications for anticoagulant therapy, venous ligation and anesthesia of the paravertebral sympathetic system.

Sixteen of 31 patients with venous thrombosis had pulmonary infarcts before the diagnosis of peripheral venous thrombosis was made. All 31 patients were treated primarily with subcutaneous administration of heparin and dicumarol. Five of the 31 patients had ligations of the superficial femoral vein, and 3 had paravertebral sympathetic blocks. All recovered.

PATHOGNOMONIC SIGN FOR CYST OF THE KNEE CARTILAGE

ANTHONY J. PISANI, M.D.
NEW YORK

IN 1938, while on Dr. Arthur Krida's Orthopedic Service at Bellevue Hospital, I removed a cyst of the medial meniscus. It was observed at that time that the hemispherical cystic mass disappeared into the knee

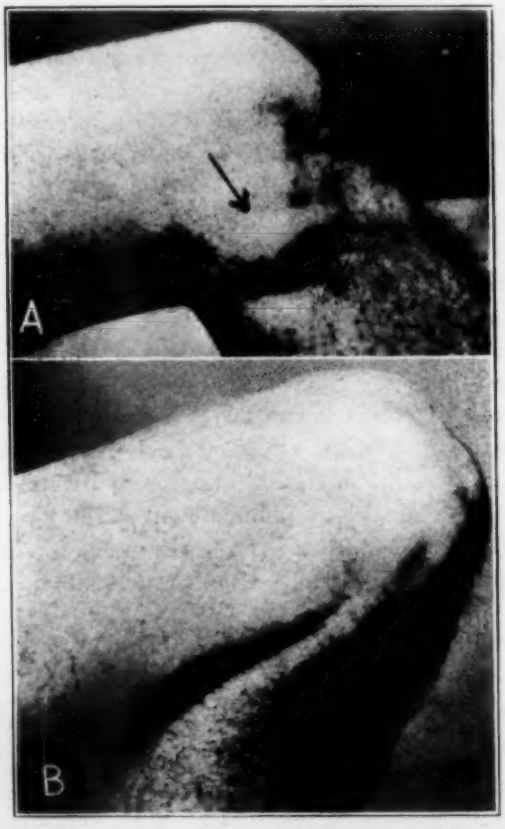

Fig. 1.—*A*, cystic mass at the level of the joint cleft at 60 degrees. *B*, disappearance of the cystic mass on acute flexion.

joint on acute flexion and reappeared on extension of the knee, reaching its maximum dimensions at a point 25 to 30 degrees short of complete extension.

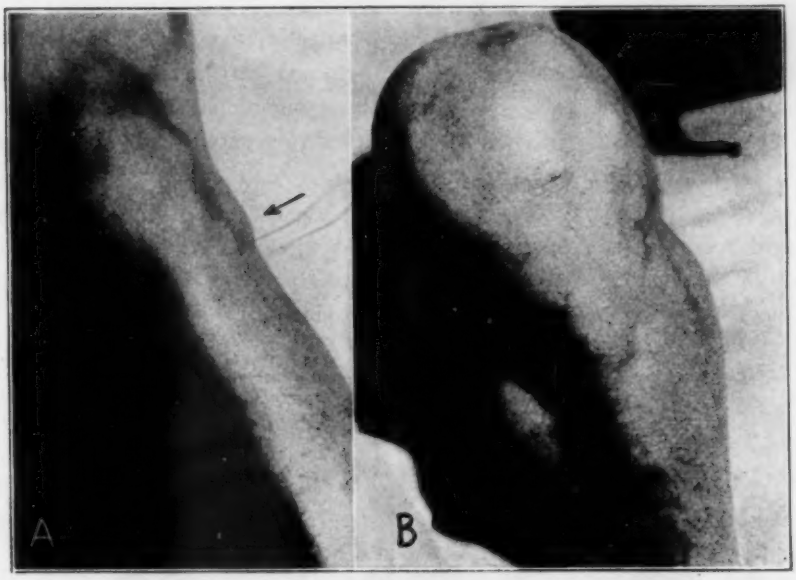

Fig. 2.—*A*, cystic mass on extension. *B*, the "disappearing sign."

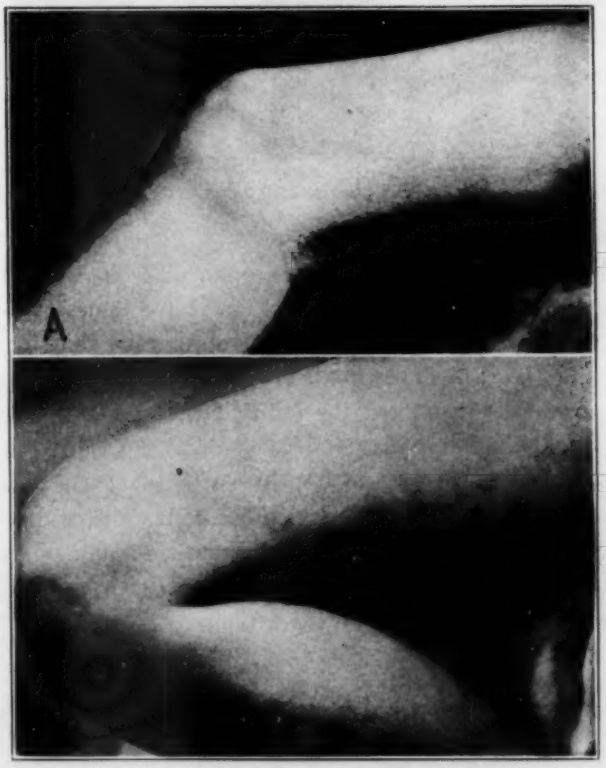

Fig. 3.—*A*, cyst appears on incomplete extension. *B*, cystic mass has rotated into knee joint in flexed position.

In 1943 I presented before the Canal Zone's Isthmian Medical Society a series of twelve cysts of the knee cartilages, both internal and external. The pathognomonic "disappearing sign" was described as a common finding in each of the patients operated on by Lieutenant Colonel Marcus Schwartz and me.

During the past three years eighteen more cysts of the medial and lateral menisci have been diagnosed and fifteen of them excised. In each of this last series the physical sign was present, viz., disappearance on acute flexion and reappearance on extension.

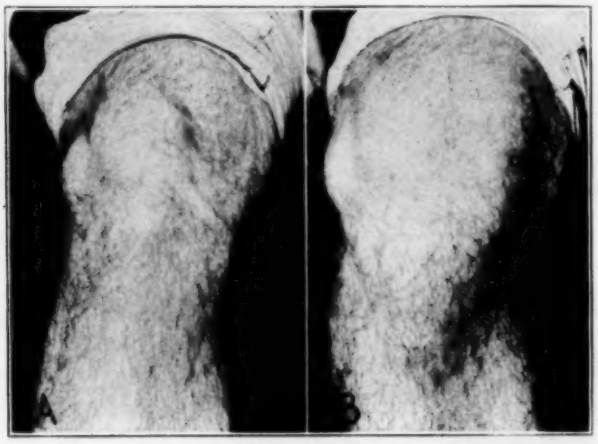

Fig. 4.—*A*, lipoma with the knee in extension. *B*, lipoma with the knee in flexion.

In figures 1 *A*, 2 *A* and 3 *A* the firm tumor mass appears on extension of the knee in each case. On acute flexion of the knees (figs. 1 *B*, 2 *B* and 3 *B*) the hemispherical cystic mass disappears due to a rotation of the tibias. Figure 4 illustrates a lipoma of the lateral aspect of the knee. Its position is just above the joint cleft, and it remains prominent even on acute flexion.

SUMMARY

Thirty-one cysts of the menisci are presented. The common denominator in all cases was the physical sign of disappearance of the mass on acute flexion of the knee and reappearance on extension. The sign is pathognomonic for cysts of the knee cartilage.

PROGRESS IN ORTHOPEDIC SURGERY FOR 1945

A Review Prepared by an Editorial Board of the American Academy of Orthopaedic Surgeons

IV. CONDITIONS INVOLVING THE HIP JOINT

PREPARED BY
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(Continued from Page 115)

Fresh Fractures of the Neck of the Femur.—Whitman [75] states the belief that internal fixation of fractures of the femoral neck should be classified as a complement to the abduction method of treatment. Functional activity may predispose to necrosis of the head, and shortening of the femoral neck is not unusual in conditions treated by internal fixation. A number of cases have been reported in which spontaneous extrusion of the nail has resulted in union. Whitman directs a pessimistic outlook on patients treated by internal fixation, based on the statistics of Hey Groves, in which only 50 per cent of the bones in 75 cases united.

[Ed. Note (J. J. F.).—The author's opinion as to the merit of internal fixation versus the abduction method is in contrast to the present day reports and a study previously conducted by the American Academy of Orthopaedic Surgeons.]

Harmon [76] describes a new type of threaded, stainless steel screw to fix fractures of the femoral neck. The advantage of screw fixation is that it maintains impaction. The results in 35 cases of fresh transcervical fractures include satisfactory union with a viable head in 88.6 per cent of the cases. There were no fatalities and no cases of necrosis of the femoral head observed from one to three years. Results in 45 cases of trochanteric fractures treated by internal fixation showed satisfactory union without shortening in 88.8 per cent and a mortality rate of 11.1 per cent.

Weinberger [77] discusses stress lines in mediocervical fractures of the neck of the femur and demonstrated that Godoy Moreira's technic

75. Whitman, R.: A Retrospective Commentary on the Campaign for the Establishment of the Positive Standard of Treatment for Fracture of the Neck of the Femur, J. Bone & Joint Surg. **27**:334-339 (April) 1945.

76. Harmon, P. H.: The Fixation of Fractures of the Upper Femur and Hip with Threaded, Hexagon-Headed, Stainless-Steel Screws of Fixed Length, J. Bone & Joint Surg. **27**:128-137 (Jan.) 1945.

77. Weinberger, M.: Resultados tardios de seis observações de fraturas de colo femoral por adução tratadas pela ósteo-síntese-extra-articular com prótese do Prof. Godoy Moreira, Rev. brasil. de cir. **13**:401-418 (Aug.) 1944.

permits modifications of these stress lines in such a way that an adduction fracture will approximate an abduction fracture, in which the chances for union are always good. Six cases of adduction fractures treated by this method with good results are described.

Wadstein [78] emphasizes the advantages of using a helicoid screw for fixation of fractures of the femoral neck. Seven of the 37 patients treated by this method died within six months after operation, and the 30 remaining patients secured a good osseous union.

According to Stuck,[79] fixation of fractures of the femoral neck can be accomplished by using the palpating finger on the line of fracture, so that no roentgenograms or guides are required. Through a lateral incision over the trochanter, the anterior aspect of the femoral neck is exposed by reflection of the anterior capsule. The reduction is checked by the finger, while an assistant makes traction on the leg and manipulates. A Smith-Petersen nail is then inserted, being aimed at the finger placed at the site of fracture. A pillow is placed under the extremity postoperatively to prevent internal rotation, and the patient is permitted to move freely in bed, although he is kept recumbent eight weeks. Stuck makes a plea for internal fixation of intertrochanteric fractures.

[ED. NOTE (J. J. F.).—It is not always easy to estimate the direction and penetration of the nail even with open reduction when roentgenologic control is not used.]

Leadbetter [80] is of the opinion that 90 per cent of fractures of the femoral neck can be reduced by the closed method, as advocated by him in 1933. The fixation of the femoral neck in the valgus position has had universal endorsement. He relies considerably on the clinical examination in determination of bony union, rather than using the roentgenogram as the sole determining factor.

Linton [81] discusses the origin, prognosis and complications and treatment of intracapsular fractures of the femoral neck, based on an experience with 365 cases. One hundred and forty-five cases were followed for more than two years. Impacted fractures should be treated more frequently with recumbency. Adduction fractures have a poor

78. Wadstein, T.: Osteosynthesis with Screws in Medial Fractures of Neck of Femur, Acta orthop. Scandinav. **14**:251-269, 1943.

79. Stuck, W. G.: Fractures of Hip as a Problem in Military Surgery, Mil. Surgeon **96**:58-64 (Jan.) 1945.

80. Leadbetter, G. W.: The Problem of the Fractured Hip, Nebraska M. J. **30**:309-313 (Sept.) 1945.

81. Linton, P.: On Different Types of Intracapsular Fractures of Femoral Neck: Surgical Investigation of Origin, Treatment, Prognosis and Complications in 365 Cases, Acta chir. Scandinav. (supp. 86) **90**:1-122, 1944.

prognosis, a large number showing necrosis and pseudoarthrosis. Unfavorable factors were age, posterior defect, decided obliquity of the fractured surface and insufficient obliquity of the nail. Pseudoarthrosis following union was occasionally encountered. Union occurred in 83.6 per cent of the series and in 80.3 per cent of nailed adducted fractures.

Speed [82] expresses the opinion that postoperative infections following internal fixation of the femoral neck are not so uncommon as the infrequency of reports would indicate. The onset is often insidious and not alarming. Loss of weight and strength, discharging sinuses and even dislocation of the hip may occur. Four patients referred to him after the onset of this complication were treated, with favorable results. The fixing agent is removed and the femoral head excised. The neck is then placed in the acetabulum, the wound packed with petrolatum gauze and a body cast applied. He recommends use of large doses of penicillin.

[ED. NOTE (J. J. F.).—The author emphasizes a complication that is too often ignored. This hazard is more frequent and serious in cases in which internal fixation is performed by open reduction.]

McElvenny,[83] in discussing fractures of the femoral neck, believes that the fate of the femoral head depends more on an adequate reduction than on an irreparable damage to its blood supply at the time of the fracture. He states the belief that many are pathologic in nature and that the fall is caused by the fracture. Open operation is necessary only in an occasional case. The author recommends preliminary Russell traction and encouraging the patient to move about in bed and turn from back to side every two hours, with a mattress protector placed between the rubber sheet and bed sheets, to prevent irritation of the skin. In about ten days, if the condition of the patient is satisfactory, operation is performed, pentothal sodium being used for induction and then 60 per cent nitrous oxide and 40 per cent oxygen anesthesia. The limb is pulled down in external rotation and slight abduction, and, with traction still applied, the hip is toggled until the neck passes the head and then the limb is adducted to neutral or slightly beyond. The patella should then face directly medially. The reduction is satisfactory when the limb is in complete internal rotation and the neck fragment is well under and well inside the head fragment, as shown in the anteroposterior view and when there is no angulation between the head and the neck in the lateral view. A Smith-Petersen nail is threaded over a guide wire

82. Speed, K.: Treatment of Post-Operative Infections Following Internal Fixation for Fracture of the Neck of the Femur, Surg., Gynec. & Obst. **80**:479-484 (May) 1945.

83. McElvenny, R. T.: Roentgenographic Interpretation of What Constitutes Adequate Reduction of Femoral Neck Fractures, Surg., Gynec. & Obst. **80**:97-106 (Jan.) 1945.

and, ideally, should enter the shaft at or below the level of the lesser trochanter, run through the lower one half of the neck and center the head in both planes. If the hip cannot be reduced satisfactorily, or at the first sign of failure, an intertrochanteric or subtrochanteric osteotomy should be performed immediately. In a series of 38 consecutive cases followed from eighteen months to four years, there were 4 cases of failure and only 1 death, which occurred three years following the fracture.

Birch-Jensen [84] reports on 63 cases of internal fixation for fractures of the femoral neck. In 10 cases of necrosis of the femoral head, the necrosis in 7 was detected more than twelve months subsequent to operation. Functional results were good in only 44 per cent of the cases. The period of observation was more than one year in all but 15 per cent of the cases.

Wardle,[85] after studying 50 cases of treated intracapsular fractures of the femoral neck, feels that pinning is indicated because it decreases the incidence of hypostatic pneumonia and sepsis from bed sores and gives freedom from immobilization, but he states the belief that the percentage of bony union is no greater than that obtained by immobilization in a cast. He is of the opinion that perforation of the guide wire through the articular cartilage, permitting synovial fluid to gain entrance through the channel of fixation, might account for the displacement of the nail in some cases. He suggests addition of a bone graft to the method of internal fixation.

[ED. NOTE (J. J. F.).—The advisability of placing a bone graft across the site of fracture at the time of internal fixation for fractures of the femoral neck might be questioned on the basis of increasing the operative hazard and the lack of evidence that it would actually increase the incidence of union.]

Virgin and MacAusland [86] have found a traction screw designed by one of the authors to be an efficient form of internal fixation. A special spring arrangement that provides for a take-up in the event of absorption about the line of fracture is described, and the principle is illustrated by roentgenograms.

Haas [87] describes a case of longitudinal fracture of the femoral head associated with a dislocation treated by closed and later by open reduc-

84. Birch-Jensen, A.: Resultate der Osteosynthesis collis femoris a. m. Sv. Johansson, Acta chir. Scandinav. **87**:433-440, 1942.

85. Wardle, E. N.: Subcapital Fractures of Femoral Neck: Fixation by Pin and Graft, Lancet **1**:399-402 (March 31) 1945.

86. Virgin, H., Jr., and MacAusland, W. R.: A Continuous Traction Screw for Fixation of Fractures of Hip: Review of Twenty-Three Cases, Ann. Surg. **122**:59-67 (July) 1945.

87. Haas, S. L.: Longitudinal Fracture of Head of Femur Associated with Dislocation of Femur, Am. J. Surg. **69**:402-405 (Sept.) 1945.

tion, with failure. Subsequently, arthrodesis was performed, which did not result in complete consolidation; however, 40 degrees of painless motion was present. He feels that closed reduction should first be attempted in these cases and, later, open reduction or arthrodesis if necessary.

March Fractures of the Neck of the Femur.—Gibbens [88] reports the case of march fracture of the femoral neck in a soldier who experienced sudden severe pain in his right hip while marching and was unable to bear weight. He was found to have muscle spasm on rotation and limited motion on extension. The initial roentgenogram showed only a loss of continuity of the cortical neck inferiorly. The line of fracture, however, was found to involve the entire neck three weeks subsequently.

Bingham [89] reports a case of a march fracture of the femoral neck in a youth 18 years of age, resulting in a varus deformity, such as occurs typically in fractures due to gross violence. He thought that the case was unusual so far as the degree of displacement was concerned.

Intertrochanteric Fractures.—Compere [90] is of the opinion that in intertrochanteric fractures death is more frequent than and poor results almost as common as those obtained in the treatment of fractures of the femoral neck. He feels that the common cause of deformity is usually too short a period of immobilization. If traction is used, it should be maintained for twelve weeks. He favors open reduction with use of the Compere plate and threaded pins. He feels that the chances of death, malunion, the evil sequelae of stiff knees and circulatory edema are minimized by internal fixation.

Gosse [91] finds the mortality rate in intertrochanteric fractures higher than in those of the femoral neck. As a group, patients with intertrochanteric fractures are older, and there is more damage to the bone, resulting in hemorrhage, pain and shock. He advocates internal fixation with the patient under local anesthesia for both types of fracture and treats them postoperatively with a bar fastened with plaster to the foot, to prevent external rotation.

[ED. NOTE (J. J. F.).—Traction during the first ten days to two weeks subsequent to operation seems indicated, and, with the extremity resting on a pillow, external rotation is usually controlled.]

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88. Gibbens, M. E.: March Fracture of the Neck of the Femur: A Case Report, J. Bone & Joint Surg. **27**:162-163 (Jan.) 1945.

89. Bingham, J. A. W.: Stress Fracture of Femoral Neck, Lancet **2**:13-14 (July 7) 1945.

90. Compere, E. L.: The Treatment of Intertrochanteric Fractures of the Femur, Mississippi Valley M. J. **67**:13-18 (Jan.) 1945.

91. Gosse, N. H.: Fractures of Neck of Femur, Nova Scotia M. Bull. **23**: 302-308 (Nov.) 1944.

Lusskin [92] found that aboard ship, where apparatus and beds are at a premium and evacuation and transportation are often emergencies, the simplest method for treating intertrochanteric fractures is reduction of the fracture by traction, insertion of pins through the lower end of each femur and a double hip spica cast incorporating the pins.

Cohn and Vonburg [93] discuss the merit of blade plate fixation of intertrochanteric fractures. They emphasize that failures may occur by this method in cases in which there is pronounced comminution of the greater trochanter or when the shaft and greater trochanter form a thin shell of bone.

Posch and Abbott [94] have studied the end results of fourteen intertrochanteric fractures treated by the hanging cast. Most of the fractures were so comminuted that nailing was thought inadvisable. There was only one death. The position in the remaining cases, as well as the hip motion, was good. The stiffness of the knee and ankle in most instances was corrected by physical therapy.

Nonunion.—Hermann [95] reviews 8 cases of nonunited fractures of the hip treated by McMurray osteotomy and reported in 1941 and gives his experience in 11 more cases of such reconstructions done at the Boston City Hospital by various surgeons since that time. Five of the 8 patients originally reported and thought to have a satisfactory result were recently reexamined, and 2 of them were found to have lost some of their local hip motion and showed an increase in shortening, because of some change in position of the distal fragment, due to lack of real bony union. Two patients died soon after operation, despite the apparent simplicity and shortness of the operation. One can expect 80 per cent to walk with a slight limp and to walk up and down stairs with a cane. Some have moderate pain at the end of a day and have difficulty in crossing their legs. The author feels that the operation is not so simple and non-shock-producing as originally thought, and candidates for the operation should have a fairly viable head and some femoral neck and must be a good surgical risk. The operation should not be universally adopted for nonunion, but the surgeon should choose the best-adapted procedure for each particular case.

Stewart [96] recommends screw fixation following osteotomy for ununited fractures of the neck of the femur, in order to eliminate immo-

92. Lusskin, H.: Intertrochanteric Fractures of the Femur: Early Care on a Hospital Ship, U. S. Nav. M. Bull. **44**:1221-1227 (June) 1945.

93. Cohn, B. N. E., and Vonburg, V. R.: Surgical Treatment of Intertrochanteric Fractures, Rocky Mountain M. J. **42**:587-592 (Aug.) 1945.

94. Posch, J. L., and Abbott, W. E.: Treatment of Intertrochanteric Fractures of Femur: Use of Hanging Cast, Am. J. Surg. **70**:369-373 (Dec.) 1945.

95. Hermann, O. J.: The McMurray Osteotomy for Nonunited Hip Fractures, New England J. Med. **232**:186-189 (Feb. 15) 1945.

96. Stewart, J. D.: Subtrochanteric Osteotomy for Treatment of Nonunion of Hip Fractures, Northwest Med. **44**:112-117 (April) 1945.

bilization in a cast and to permit early motion. Of 11 cases, the results were good in 4, fair in 3, poor in 2 and failures in 2.

[ED. NOTE (J. J. F.).—Screw fixation does not seem to be so effective for internal fixation following osteotomy as the Blount blade plate.]

Guilleminet [97] found osteotomy an effective procedure for congenital coxa vara. Anatomic and functional results two years subsequent to operation were good in a boy of 11½ years of age and a girl of 9 years.

Dislocation.—Werneck [98] states the belief that dislocations of the hip are easy to reduce by manipulation only within the first forty-eight hours. Persistent dislocation is a serious handicap, and surgical reposition frequently results in partial ankylosis. There are four types, namely, posterior, including iliac and sciatic types, and anterior, including pubic and ischiopubic types. Reduction should not be attempted without anesthesia. The method of reduction is illustrated in the various types of dislocations.

Arthrodesis.—Haggart's [99] experience with conservative treatment and arthroplasty for degenerative arthritis in the age group from 50 to 65 has not been satisfactory. Arthrodesis performed in two stages has given the most satisfactory results. Ten of 12 patients obtained bony ankylosis and complete relief of pain and ability to return to their previous activities. There were two failures. Patients with involvement of both hips are not suitable for arthrodesis. The operation is done in two stages. In the first operation, the excess bone and cartilage of the head of the femur are cut away by a chisel and completed by a cup reamer. Drill holes, 1/16 inch (0.16 cm.), are made in the head by a motor-driven saw. A motor-driven burr is then used to remove the acetabular cartilage and a drill used to make multiple holes in the acetabulum. Approximately two weeks later, again with the patient under spinal anesthesia, a fracture table being used, a Smith-Petersen nail is threaded over a guide wire and inserted, as suggested by Watson-Jones.

[ED. NOTE (J. J. F.).—It would seem likely that the preliminary removal of the articular cartilage of the joint and drilling was a great aid in obtaining such a high percentage of successful unions.]

Karlén [100] employed various means of obtaining fusion in 47 cases of osteoarthritis of the hip and in 12 cases of septic sequelae of conditions

97. Guilleminet: Traitement chirurgical de la coxa-vara congénitale, Lyon chir. **37**:350-354, 1941-1942.

98. Werneck, C.: Luxação coxo-femural, Rev. brasil. med. **1**: 1047-1049 (Dec.) 1944.

99. Haggart, G. E.: Degenerative Arthritis of the Hip Joint Treated by One or Two Stage Arthrodesis with Metal Fixation (Watson-Jones), J. A. M. A. **128**:502-507 (June 16) 1945.

100. Karlén, A.: Arthrodesis in Osteoarthritis of Hip and Septic Coxitis Sequels, Acta chir. Scandinav. **89**:309-321, 1943.

involving the hip. Of the patients operated on for osteoarthritis, bony ankylosis was obtained in 36, fibrous ankylosis in 4 and no consolidation in 6. One patient died of shock. In his series of 12 cases of septic sequelae of conditions involving the hip, bony fusion occurred in 10 and nonunion in 1 and there was 1 death.

Neurectomy.—Mallet-Guy and de Mourgues [101] describe the case of a 49 year old man treated for chronic arthritis of the hip by endopelvic section of the obturator nerve, resulting in freedom of pain and improvement of motion. There was no anesthesia on the internal aspect of the thigh. They cite the results of Tavernier, who obtained good results in 9 cases of arthritis of the hip by section of the obturator nerve.

Cottini [102] reviewed the literature on obturator neurectomy for arthritis deformans of the hip. It is advocated in cases in which surgical procedures are contraindicated, such as poor general condition, bilateral lesions and obesity, and in which there is contracture of the adductor muscles. Immediate results were encouraging, but, as time progressed, symptoms usually recurred. Of 11 cases, the results were good in 5 and fair in 2. In 3 cases in which fibers of the femoral and sciatic nerves were sectioned in addition to the obturator nerve, the results were more encouraging.

After studying the results of radicotomy of the third, fourth and fifth lumbar roots, performed in 15 cases of arthritis deformans of the hip joint, Karlén [103] is of the opinion that the operation is of doubtful value. The results were good in 1 case and satisfactory in 7.

Osteoarthritis.—Hermodsson [104] is of the opinion that the roentgenologic signs of osteoarthritis of the hip indicate a definite connection with the anatomic build of the joint. The importance of structural changes and stresses resulting from variation of the angle of the femoral neck is emphasized.

Waugh [105] found that the synovial fluid of the hip in cases of chronic osteoarthritis appeared to be consistently on the alkaline side.

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101. Mallet-Guy, P., and de Mourgues, G.: Arthrite chronique de la hanche traitée par section endopelvienne du nerf obturateur, Lyon chir. **37**:262-264, 1941-1942.

102. Cottini, G. F.: El tratamiento del dolor en la artrosis deformante de cadera, por la neurotomía del obturador (operación de Selig), Bol. y trab., Soc. argent. de cirujanos **6**:336-358, 1945; Rev. Asoc. méd. argent. **59**:884-891 (Aug. 15) 1945.

103. Karlén, A.: Division of Fourth Lumbar Nerve Root in Treatment of Arthritis Deformans of Hip, Acta chir. Scandinav. **90**:410-418, 1944.

104. Hermodsson, I.: Different Types of Osteoarthritis in Hip Joint and Their Connection with Anatomical Conditions: Does There Exist Any Subluxatio Coxae Acquisita? Acta radiol. **25**:527-550, 1944.

105. Waugh, W. G.: Monoarticular Osteoarthritis of Hip: Treatment by Acid Injection, Brit. M. J. **1**:873-874 (June 23) 1945.

The injection each week of 15 to 20 cc. of a solution of lactic acid of p_H 5.8 together with procaine hydrochloride into and around the hip joint was followed by gradual exercises. He found improvement in 50 to 60 per cent of 26 consecutive patients treated by this method.

Watson-Jones [106] has used the Smith-Petersen nail for arthrodesis of the hip in 135 cases of degenerative arthritis since 1931. Experience has shown that, unless a hip is already extremely stiff, arthrodesis with a nail alone is not adequate. He has found that by removal of the articular cartilage from the joint at the first stage and fixation at the second stage there was much less shock than with the combined intra-articular and extra-articular arthrodesis with an iliofemoral bone graft. He expresses the opinion that arthrodesis is the procedure of choice in unilateral involvement of the hip. In the same paper, Pridie gives his experience in arthroplasty for arthritis of the hip. The operation was found to be poor in cases of ankylosing arthritis and aseptic necrosis.

Slipped Femoral Epiphysis.—Green [107] analyzes a consecutive series of slipped femoral epiphyses of 26 patients, with thirty-six hips involved. In hips with minimal displacement, nailing without arthrotomy gave good results. In hips with minimal to moderate displacement, the best results were obtained by a method of using a particular combination of traction and plaster fixation. Open reduction and fixation gave good results in hips with severe displacement, provided certain technical criteria, such as recognizing the vessels on the posterior-inferior portion of the neck and avoiding the severance of them at operation, were observed. Closed manipulated reduction could not be recommended.

Moore [108] describes 2 cases of slipped femoral epiphyses that resulted in aseptic necrosis. In 1, bony union occurred and most of the articular cartilage remained alive, but the articular cartilage was narrowed as a result of degenerative changes and ossification in its deeper zone. In the other, there was nonunion and both the ossification center and the articular cartilage became necrotic. There was only a small portion of the epiphysis replaced by new bone, and the articular cartilage underwent absorption and fibrocartilaginous replacement or ossification during the process of repair. The author states that following interruption of the blood supply to the epiphysis in adolescence the overlying articular cartilage may remain viable or undergo partial or

106. Girdlestone, G. R.; Watson-Jones, R.; Slamm, T. T., and Pridie, K. H., in Discussion on Treatment of Unilateral Osteo-Arthritis of the Hip Joint, Proc. Roy. Soc. Med. **38**:363-368 (May) 1945.

107. Green, W. T.: Slipping of the Upper Femoral Epiphysis: Diagnostic and Therapeutic Considerations, Arch. Surg. **50**:19-33 (Jan.) 1945.

108. Moore, R. D.: Aseptic Necrosis of the Capital Femoral Epiphysis Following Adolescent Epiphyseolysis, Surg., Gynec. & Obst. **80**:199-204 (Feb.) 1945.

complete necrosis, and in either instance degenerative or reparative changes result in reduction of depth of the articular cartilage. These changes are in contrast to those seen in Legg-Perthes disease, in which rapid growth of the living articular cartilage compensates for whatever absorption or ossification of the cartilage takes place following revascularization in the ossification center.

Arthroplasty.—Fernández [109] has used an approach between the tensor fascia and gluteus medius muscles to gain access to the hip for arthroplasties, arthrodesis, reconstructive operations like those of Whitman and Brackett and other conditions involving the region of the hip. Few vessels are encountered, and frequently the entire operation can be completed without ligation. The only anatomic obstacle to this operation is that one of the terminal branches to the tensor muscle from the superior gluteal nerve crosses the field.

[Ed. Note (J. J. F.).—The tensor and gluteal muscles are closely attached, and their separation usually causes bleeding from several small branches, which is not so easy to control as when the approach is made medial to the tensor muscle.]

Karlén,[110] after studying 16 cases of arthroplasty performed for arthritis deformans, 7 with fascia lata and 9 with vitallium cups, concludes that in arthritis deformans of the hip joint the chance of a successful result from arthroplasty is small. The results were good in 2 cases and only fair in 5. Unsatisfactory results were obtained in patients over 30 years of age and those engaged in strenuous occupations. He feels that the operation should be used only when the patient is absolutely dependant on a movable joint for continuance of his occupation, and then it should be done with fascia lata.

[Ed. Note (J. J. F.).—It is generally felt that vitallium cups are superior to fascia lata, and certain authors, having a large experience with fascia lata arthroplasties, have abandoned it in favor of vitallium cups. This article is one of the more pessimistic ones on arthroplasty.]

Batchelor [111] reports on 5 cases of ankylosing spondylitis of the hips and spine treated by excision of the head and neck of the femur. In 4 patients bilateral excision was performed. In 2 of these patients osteotomies were combined with the operation. He expresses the opinion that excision followed by osteotomy is indicated in patients who are

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109. Fernández, L. L.: Cadera y cuello del fémur; su abordaje por la vía entre el tensor de la fascia lata y el glúteo medio, Prensa méd. argent. **32**:1289-1292 (July 6) 1945.

110. Karlén, A.: Arthroplasty in Arthritis Deformans of Hip Joint, Acta chir. Scandinav. **90**:482-494, 1944.

111. Batchelor, J. S.: Excision of the Femoral Head and Neck in Cases of Ankylosis and Osteoarthritis of the Hip, Proc. Roy. Soc. Med. **38**:689-690 (Oct.) 1945.

young and have a reasonable chance of returning to an active and useful life. In older patients, in whom the chief purpose of treatment is to restore motion of the hip so as to allow them to sit comfortably about their home, excision is probably all that is required.

V. CONDITIONS INVOLVING THE FOOT AND ANKLE

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Static Strain on the Feet.—Pemberton [112] reports on the care of soldiers' feet. He says that mild strain on the feet manifested only by pain in the feet and legs on walking, plus tenderness, requires no treatment except proper fitting of shoes and foot hygiene. The commonest condition is faulty posture of the feet, resulting in one of the several types of flatfoot. Treatment is directed at correction of the pronation. Mild conditions are treated with a 3/16 inch (0.48 cm.) inner heel wedge. A firm flexible arch support is used in severer conditions, with the high point under the sustentaculum tali. Steel arch supports have no place in the Army. The flexible support is made of shoe leather with properly fitted felt pads. For a congenital weak foot, flexible arch supports and taping are advised. Congenital flatfoot is not disabling and probably no more subject to strain than the "normal" foot. It should not be fitted with an arch support. Shoes with a sufficient width of the shank are advised. If the condition is symptomatic, there is no satisfactory treatment in the Army. Flatfoot in the Army should not be considered a pathologic entity of serious import. It is no more likely to be symptomatic than the foot with a longitudinal arch, and it is subject to strain in the same manner. Spastic flatfoot is easily recognized and is a serious disability not ordinarily compatible with full duty in the Army. Acute strains should be treated by rest and taping, as should tenosynovitis. More or less permanently disabling problems concerning the feet should not be treated in the Army, and these include pes cavus, hallux valgus, spastic flatfoot, either post-traumatic, gonorrheal or part of a generalized arthritic syndrome, paralytic foot, congenital deformity and multiple congenital hyperkeratosis.

[ED. NOTE.—This is a report of what has been done for these conditions of the feet and likely what will be continued to be done in the Army. The paper is based on actual experience with soldiers who have had pedal disorders.]

112. Pemberton, P. A.: The Care of Soldiers' Feet, Bull. U. S. Army M. Dept., January 1945, no. 84, pp. 110-117; Arch. Phys. Med. **26**:282-289 (May) 1945.

Kark [113] states that the cause of foot strain in the services is overuse, fatigue of the muscles of the foot that support the body weight and consequent strain of the ligaments. The outstanding circumstance is a too rapid transference from relative inactivity to full stress of military life. The rubbing of the boot on a corn, blister, callosity or wart, traumatic arthritis of a stubbed great toe and pain of an ingrown toe nail are all examples of conditions which may throw the foot out of its normal position. Under such conditions the muscles fatigue much more readily, and foot strain is soon added as the major source of disability. Both sources of trouble require treatment. Varying degrees of "Charlie Chaplin" gait and poorly developed muscles of the trunk and limbs may throw the weight bearing out of alinement.

The author advises more instruction regarding foot hygiene and the immediate reporting of minor complaints in the foot. The treatment recommended for foot strain may be divided into three stages: (1) a period of absolute rest in bed (the average period is from two to five days); (2) a period of non-weight-bearing exercises with gradual progression (light massage and contrast baths are helpful), and (3) a period of weight-bearing exercises (again progress is graduated). At first the patient gets up only for the exercises; later he is up between exercises. Weight-bearing exercises are designed to correct stance and gait to achieve full muscular power in balance at rest and in propulsion. Persistent pain in the presence of improved muscle power, and not stiffness, partial mobility or mild deformity, is regarded as the indication for manipulation. When manipulation is performed, it is done according to the technic of Bankart.

The author chooses to regard the condition in all cases as primarily the result of overuse and muscular fatigue and to treat patients from this point of view. He states that the adoption of this attitude is emphatically indicated by almost uniform failure of boot wedges, bars and arch supports and the patent evidence that the minor operations on the feet in civilian practice produce major disability in service personnel. Adequate treatment of acute and chronic strain on the feet requires hospitalization of two to six weeks.

[ED. NOTE.—The problem of taking care of people in the service always has to do with whether or not they want to get well, so that even minor disabilities, if treated surgically, may turn into major disabilities. We feel that nothing should be done to any of these persons unless one is sure that they want to get well, and then we think that proper conservative correction will relieve them and rehabilitate them in nearly every case. Surgical procedures should be necessary only in cases in

113. Kark, W.: Foot Strain in the Services, J. Roy. Army M. Corps **83**:166-171 (Oct.) 1944.

which the condition to be corrected is one that will prevent the carrying out of proper conservative measures resulting in reestablishment of normal function.]

Hartley [114] expresses the opinion that instruction of the soldier in correct walking is a necessary aid in the treatment of weak feet and a prophylaxis against foot strain in normal feet. Correct walking has a beneficial effect on the muscular, ligamentous and osseous support. In normal gait the swing is free at the hips, the weight is carried from the outer part of the heel, the os calcis being kept in varus, and the weight is carried along the outer border of the foot to the head of the fifth metatarsal and then across the metatarsal arch to the head of the first metatarsal. The great toe is directed forward or is slightly internally rotated. In cases of mild pes planus, correct walking is sufficient.

[ED. NOTE.—We agree definitely that correct walking is the best exercise. The only problem is that the abnormal foot has to be brought into normal position so that correct walking can be carried out.]

Daniels and Wilson [115] report on a survey of complaints relating to the feet on road marches and state that the common types of complaints relating to the feet in the unseasoned troops of this study were pain in the achilles tendon, blisters, bony pain, which is essentially metatarsalgia, and burning sensations of the plantar area. The authors felt that some of the causes of these common complaints regarding the feet, based on observations during these marches, were improper shoes, improperly fitted or conditioned shoes, lack of previous physical conditioning, broken or improperly fitted arch supports, improper socks, anatomic abnormalities of the feet and mycotic infections.

[ED. NOTE.—We think that this group would also improve by having correct gait, and we do not believe that a man should be expected to do active duty with arch supports.]

Splithoff [116] gives a short discussion of weak feet in naval personnel and states that treatment consists essentially of proper footgear, with added correction when indicated, exercises, massage and contrast baths.

[ED. NOTE.—We suggest that it might be more practical to carry out functional exercises, primarily normal gait.]

King [117] presents the classic picture of march fracture of the second, third or fourth metatarsal bones, with metatarsalgia, limp, possible tenderness and redness and the latent roentgenologic changes.

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114. Hartley, J.: Gait and the Soldier: Importance of Gait in Prevention and Cure of Foot Strain, Mil. Surgeon **96**:177-182 (Feb.) 1945.

115. Daniels, B. T., and Wilson, C. H.: A Survey of Foot Complaints on Road Marches, Mil. Surgeon **97**:306-312 (Oct.) 1945.

116. Splithoff, C. A.: Symptomatic Weak Feet in Naval Personnel, U. S. Nav. M. Bull. **44**:1045-1047 (May) 1945.

117. King, I. J.: March Fracture, Indust. Med. **14**:8-10 (Jan.) 1945.

Histories of 2 typical cases of factory workers are given. If there is an alteration in the relationship of the bones of the foot such as in flatfoot, then it is conceivable that slight repeated bending forces might cause march fractures.

Eddy [118] reports 3 cases of march fracture among women employees of a shell-loading plant during a period of only eighteen months. As is true in all injuries occurring at work, the question of compensability arises.

Trench Foot and Immersion Foot.—White and Scoville [119] consider two conditions, trench foot and, its sea-going counterpart, immersion foot, both being caused by prolonged exposure of the dependent lower extremities to cold and moisture. Occasionally, when a man is forced to kneel or sit for prolonged periods on the bottom of a rubber raft, this same condition is seen involving the knees and buttocks. Immersion foot and trench foot differ from frostbite simply because the tissues are not actually frozen. If trauma by walking occurs infection usually follows, and it often ends in moist gangrene. After exposure at sea, infection and gangrene are fortunately less frequent, because circumstances prevent trauma to the feet by ambulatory activity. When first seen after exposure, in either trench foot or immersion foot, the feet are cadaveric in color, swollen and blistered. Massive gangrene from the ankle may appear imminent, but when there is no infection and proper treatment is administered the recovery capacity is amazing. Recovery takes place in two stages: an early hyperemic stage and a later period of fibrosis. If the exposure was prolonged, incapacity may be present in both phases.

In treating these patients, one must keep the patient off his feet and protect him against rupture of the blebs and the formation of pressure sores in the weight-bearing areas of the anesthetic skin. If streptococcic infection begins, moist gangrene and loss of the leg are apt to follow. The general effects of cold should be combated by warming the body with blankets and hot water bottles and giving hot tea, coffee or soup internally. The injured feet must be kept cool while the body is warmed. A nutritious high protein, high vitamin diet should be given as soon as tolerated. If the vitality is low, plasma transfusions to combat shock and hypoproteinemia are valuable. Elevating the legs helps drain edema fluid and shrinks the blisters. If gangrene has already developed, the extremities can be saved usually by conservative

118. Eddy, J. H., Jr.: March Fracture in Industry, Indust. Med. **13**:1028 (Dec.) 1944.

119. White, J. C., and Scoville, W. B.: Trench Foot and Immersion Foot, New England J. Med. **232**:415-422 (April 12) 1945.

amputation of the toes and distal portions of the feet. Early amputation of a leg is excusable only in fulminating lymphangitis, threatened septicemia or gas gangrene. Sympathectomy is illogical in the early hyperemic stage. The authors express the opinion that unilateral sympathectomy should be tried in bilateral severe trench foot with atrophy, rigidity and fibrosis.

[ED. NOTE.—This article is based on experience with trench foot and immersion foot during the war.]

Greene [120] enumerates several precautionary measures in equipment and care of the feet as preventives against the frequently avoidable trench foot. He makes some practical suggestions with regard to socks and the use of diet and recommends standing in dry trenches instead of wet trenches.

Friedman [121] studied the morphologic changes in 14 cases of trench foot seen recently and found that usually the damaged portion of the foot was sharply demarcated from the leg at a level slightly below the malleoli. In a few cases gangrene was restricted to the toes, but usually it involved the whole foot. In the early cases, the capillaries and small vessels were decidedly engorged and the medium-sized vessels were dilated and thin walled. There was hemolysis in some small vessels. Numerous vessels contained agglutinative erythrocytic thrombi. Mural hemorrhage and inflammation of vessels, but no periangiitis, were observed. Forty days after the original injury almost all thrombi were already organized, and both arteries and veins showed the features of endangiitis obliterans, even in tissues above the line of demarcation. Since blood flow in the deep portions of an extremity does not always parallel that in the tissues near the surface, the superficial hyperemia may not accurately reflect the state of the circulation in the muscle. The author questions whether the initial lesion is vascular or neural.

[ED. NOTE.—It is possible that the nerve and vessels are affected directly and equally by the extreme exposure.]

Schecter and Ragan [122] discuss the diagnostic value of ischemic pain in connection with trench foot. Vascular occlusion of the lower extremity by use of a 220 mm. mercury pressure in a pneumatic cuff on the thigh, with the resulting symptoms of pain, was used as a basis for the authors' opinion that the symptoms were due to ischemia.

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120. Greene, R.: The Prophylaxis of Trench Foot, Brit. M. J. **1**:270-271 (Feb. 24) 1945.

121. Friedman, N. B.: The Pathology of Trench Foot, Am. J. Path. **21**:387-433 (May) 1945.

122. Schecter, A. E., and Ragan, C. A.: Trench Foot: The Diagnostic Value of "Ischemic Pain," Bull. U. S. Army M. Dept., June 1945, no. 89, pp. 98-100.

Patterson and Anderson [123] discuss war casualties from prolonged exposure to wet and cold, and they feel that length of exposure was not the main factor in determination of the severity of the lesion. Many variations in individual susceptibility to cold and wet were noted. Susceptible persons were those with previous injuries of the feet or legs, those with signs or symptoms indicating vasomotor instability, those with any suggestion of peripheral vascular disease and those with infections of the feet. Treatment was by mechanical respiration and oxygen therapy. Alternate positive (plus 4 mm. of mercury) and negative (minus 10 mm. of mercury) pressure at the rate of 18 respirations per minute was applied to the thorax, and oxygen was administered at the rate of 3 to 5 liters per minute for one hour once or twice daily. It is claimed that this treatment improves lymphatic drainage and venous return to the heart and increases cardiac output. A steeper pressure gradient between arterioles and venules results, and blood flow through the chilled feet is thus improved. If employed in the early stages, this treatment appeared to have a beneficial effect.

Most patients with gangrene did not remain dry, and a broad moist zone of demarcation formed. The nature of the bacterial flora found in the zone of demarcation varied considerably. Roentgenologic examination frequently revealed the presence of gas in the tissues. This was not necessarily the result of an anaerobic cellulitis but might be due to the retraction of dead tissues or their liquefaction by organisms other than clostridia. All patients in whom gas bacillus infection was suspected, in addition to sulfonamide drugs or penicillin or both, were given prophylactic roentgenologic treatment. Amputation of toes should be done just distal to the apparent zone of demarcation. In some cases, amputations of toes were performed without an anesthetic. If sepsis was present, the bone was not trimmed until later. Stumps healed well, and granulating areas were prepared for early skin grafting by dressings with isotonic solution of sodium chloride and local chemotherapy.

In patients without gangrene, clawfoot almost invariably developed. Damage to small muscles, with unopposed action of the long flexor and extensor muscles of the toes, and contractures in the muscles and soft tissues of the sole are considered to have been the cause of this deformity, which, once established, remained as a permanent and severe disability. It is believed that the deformity could be reduced by the performance of suitable exercises and the use of foot supports in the acute and subacute phases of the disease.

[ED. NOTE.—This is an excellent paper on the subject.]

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123. Patterson, R. H., and Anderson, F. M.: War Casualties from Prolonged Exposure to Wet and Cold, Surg., Gynec. & Obst. **80**:1-11 (Jan.) 1945.

Hallux Valgus.—McElvenny [124] divides his paper on hallux valgus into four parts. Part I is the introduction; part II describes simple exostectomy for relief of bunion pain. He feels that when correctly performed it is one of the most satisfactory operations for the relief of bunion pain. Its application is wide, and it can be used more frequently than any other procedure. The causes are discussed at length, and the author apparently believes that the greatest causative factor is a congenital abnormal displacement of the first metatarsal from the second (metatarsus primus varus). The involved anatomy is reviewed. He advises simple exostectomy as a satisfactory procedure for relief of pain, especially in persons beyond the third decade of life, with mild to moderate degree of hallux valgus that does not require correction. In part III he describes the Silver procedure in detail, emphasizing that the crux of the operation is complete release of the adductor muscles to permit the varus position of the great toe without any tendency for recurrence of it into a valgus position. In part IV the Lapidus operation is described as an arthrodesis of the first metatarsocuneiform joint and the bases of the first and second metatarsals as a corrective procedure for the metatarsus varus in addition to a Silver type of capsuloplasty at the first metatarsophalangeal joint. The Lapidus operation is recommended for patients under 30 years.

Gottlieb [125] refers chiefly to cases of hallux valgus, wherein, he makes the point, correction of deformities of the second toe is necessary to prevent recurrence of the main condition. The second toe acts as a splint, and any flexion or extension, as in hammer toe, destroys this function. In correction of the second toe, whatever method is used, the digit is splinted in slightly flexed position.

Hawkins, Mitchell and Hedrick [126] express the opinion that the significance of the congenital varus deviation of the first metatarsal in the development of typical hallux valgus has been underestimated. They feel that correction should be by metatarsal osteotomy in all instances in which deviation of the first metatarsal is 10 degrees or more. They describe a double transverse shortening subcapital osteotomy to correct the varus deviation of the first metatarsal, in addition to a plastic repair of a medial capsuloperiosteal flap for correction of the hallux valgus through a curved incision in the skin. The bursa may or may not be excised, depending on the degree of irritative change. A Y-shaped incision is then made through the capsule and periosteum of the meta-

124. McElvenny, R. T.: A Study of Hallux Valgus: Its Cause and Operative Management, Quart. Bull., Northwestern Univ. M. School **19**:94-101, 1945.

125. Gottlieb, A.: Role of Second Toe in Bunionectomies, J. Internat. Coll. Surgeons **8**:352-353 (July-Aug.) 1945.

126. Hawkins, F. B.; Mitchell, C. L., and Hedrick, D. W.: Correction of Hallux Valgus by Metatarsal Osteotomy, J. Bone & Joint Surg. **27**:387-394 (July) 1945.

tarsal shaft. This flap is freed from the shaft, the base being left attached to the proximal phalanx. The exostosis is excised cleanly, flush with the shaft. Drill holes are placed through the metatarsal shaft in the antero-posterior plane near the medial cortex, about ½ inch (1.27 cm.) apart, the distal perforation being approximately ½ inch proximal to the articular cartilage. No. 3 chromic suture is then threaded through the drill holes. The metatarsal shaft is doubly osteotomized perpendicular to the shaft with the power saw. The interposing fragment, which should not exceed ½ inch in breadth, is then removed. The capital fragment is displaced laterally on the proximal one, the displacement being maintained by the spur on the distal fragment. The heavy suture is then tied securely, the fragments being held in firm apposition. The great toe is forcibly abducted and held in slight flexion while a plastic repair is performed on the capsuloperiosteal flap. The V-shaped flap is sutured far proximal on the metatarsal shaft to maintain the toe in the overcorrected position. Splints are reapplied firmly weekly for five weeks. At that time the patient is ready to wear a straight last oxford. Recently, weight bearing has been permitted four or five days after operation, the patient being encouraged to bear weight on the heels with the aid of crutches.

[ED. NOTE.—Even though we do not accept the theory of congenital varus of the first metatarsal as the etiologic factor, we think that it is advisable to correct it. We feel that it is an acquired deformity.]

A history of a case is reviewed by Jackson,[127] to draw attention to the possible far-reaching effects of hallux rigidus. With this case the author illustrates the importance of recognizing a stiff big toe as an occasionally disabling condition and also the importance of special investigation of the peripheral vascular system to exclude organic disease. For ten months his patient was treated for thromboangiitis obliterans when the correct diagnosis was bilateral hallux rigidus with congenital absence of the dorsalis pedis. When bilateral, this is not uncommonly a congenital effect.

The treatment of hallux rigidus by the conventional methods is unsatisfactory. It is Jackson's opinion that the successful outcome in this case depended largely on the provision of adequate shoes. Immediate provisional diagnosis was made of bilateral hallux rigidus with the changes of disuse, and the patient was encouraged to believe that he would get well. The edema of the dorsum of the feet disappeared within two days of the patient's becoming ambulatory. Pulsation in the posterior tibial arteries soon became constantly palpable, but the pulses of the dorsalis pedis were not felt. A roentgenogram showed osteo-

127. Jackson, H.: Hallux Rigidus Causing Intermittent Limping, Clin. Proc. 4:417-420 (Sept.) 1945.

arthritis of the first metatarsophalangeal joints and amputation of the distal ends of the terminal phalanges. Generalized rarefaction of the whole tarsus was so severe as to suggest a roentgenologic diagnosis of rheumatoid arthritis. Present findings gave no support to the previous diagnosis of thromboangiitis obliterans. He was put on a pedaling machine and was given special shoes, and active exercises were intensified. The patient was discharged to service leave after about two months and thereafter to duty. When seen about a year later he said that he frequently walked 10 miles (16 km.) a day.

[ED. NOTE.—We have had similar experiences in which we have seen patients with osteoporosis and vascular disturbances and conditions that have been diagnosed as thromboangiitis obliterans who have recovered entirely by using the Thomas heel and the comma-shaped bar with the inclined planes plus reestablishment of normal gait.]

Stewart [128] recommends unshod feet in cases in which protection is not needed, a fully flexible upper with a toe guard if needed, omission of heels and shoes built for the individual foot, possibly by the use of plastics. He states that the shoe heel is essentially a prosthesis for a deformity. The effect of the heel on the normal physiology of the foot is (1) decrease to absence in the tone of the postural muscles, (2) increase of the tension in the plantar fascia, (3) shortening of the leverage of the foot for propulsion, which increases the required muscular effort in the push-off, (4) a decrease of the postural power of the erector muscles of the tibia, (5) keeping the toes in more or less complete dorsiflexion, which leads to contractures, (6) increase of the weight thrown on the articular surfaces of the metatarsal heads and (7) reversal of the position of the feet, which should spread, as they are dorsiflexed.

[ED. NOTE.—This paper is interesting, but we question how practical it is.]

General.—According to Meredith,[129] foot length doubles in the fourth prenatal month, during the three months before birth to six months after, during the first four years and from the middle of the second postnatal year to the age of 18. At birth, females have attained 34 per cent of adult foot length while males have obtained only 31 per cent. At 10 years the percentages are 90 per cent for females and 82 per cent for males. Means show that the feet of white North American college students are longer than they were fifty years ago. On the whole, mean foot length in adulthood is highest for Negroes, intermediate for white persons and lowest for American Indians. The author enumerates numerous other valuable and interesting statistics on the growth of the foot.

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128. Stewart, S. F.: Physiology of the Unshod and Shod Foot with an Evolutionary History of Footgear, Am. J. Surg. **68**:127-139 (April) 1945.

129. Meredith, H. V.: Human Foot Length from Embryo to Adult, Human Biol. **16**:207-282 (Dec.) 1944.

[ED. NOTE.—This article represents some original work, and we found it interesting.]

Kaplan and Symonds [130] used roentgen rays for determination of degree of flatness of the feet. The roentgenogram is taken from the inner to the outer aspect, and a tracing is made. A table of numerical ratios is given to indicate the degree of flatness.

[ED. NOTE.—We have tried to get some clinical help from measuring by roentgen rays, but with no success.]

Goff [131] describes a technic of taking roentgenograms of the feet in weight-bearing positions. The article is accompanied with photographs of the apparatus, technic of procedure and roentgenograms.

Fischer and Van Demark [132] present a rare bilateral symmetric shortening of the fourth metacarpal and fourth metatarsal in 1 person. These anomalies have a recessive hereditary basis. The association of the pigmentary areas with this anomaly in the authors' case emphasizes that neurofibromatosis may be associated with abnormalities of bone. Treatment is symptomatic to relieve altered mechanics.

Johnson [133] describes peritendinitis as a painful swelling over a tendon which corresponds to a point of pressure, such as from a fold in the leather of a boot, which causes a nodule over the achilles tendon, the tendon of the tibialis anterior muscle or the flexor tendon of the hallux. Stiffening the posterior portion of the shoe with a metal splint to protect the achilles tendon, altered lacing of the boot and protective felt pads causing the leather to fold outward are suggested as treatment. The author describes the nodule as occurring along tendons in the foot because of pressure and friction rub at circumscribed areas, due to creases in the boots of soldiers.

Jones [134] presents a case of rupture of the plantaris muscle, observed through a traumatic wound, as a result of an indirect stretching force which dorsiflexed the foot. The length of the muscle belly of the plantaris is only one fifth of the total length, and forces that so stretch the plantaris are more likely to rupture the belly portion because tension on the muscle belly is proportionately great.

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130. Kaplan, M., and Symonds, M.: Pes Planus: A Method of Mensuration, Radiology **44**:355-356 (April) 1945.

131. Goff, C. W.: Roentgenography of Feet Under Weight Bearing Conditions, Connecticut M. J. **9**:109-113 (Feb.) 1945.

132. Fischer, F. J., and Van Demark, R. E.: Bilateral Symmetrical Brachymetacarpalia and Brachymetatarsalia, J. Bone & Joint Surg. **27**:145-148 (Jan.) 1945.

133. Johnson, H. D.: Peritendinitis, or Foot-Slogger's Nodule, Brit. M. J. **1**:193-194 (Feb. 10) 1945.

134. Jones, G. B.: The Pathology of the Ruptured Plantaris, Brit. M. J. **1**:876 (June 23) 1945.

A new instrument and simplified technic for the cure of ingrown nails is described by Whitesell.[135] The "shark fin" type of onychotome being employed, the actual operative technic following nerve block about the base of the involved toe is as follows: With the blade parallel to the nail, the instrument is forced proximal beneath the nail until the blade is under the eponychium. It is then rotated to the vertical, and the point is forced upward through the nail. As the instrument is withdrawn, the nail splits evenly and cleanly. The eponychium is then freed from the segment being removed, and, the opposite or spatula-like end of the instrument being employed, the nail segment is freed from its bed. Finally, the blade of the instrument is employed to curet the matrix or nail-forming organ.

Chatterton and Blaisdell [136] have modified the Denis Browne splint for the treatment of clubfoot. The modification consists of a transverse steel rod about ⅝ inch (1.6 cm.) in diameter and length suitable to the size of the patient. To each end of this rod is welded a clamping mechanism, which grips the soles of the shoes in the manner illustrated, much like roller or ice skates. In addition, posteriorly T straps are incorporated into the sole clamps. These straps are laced around the patient's ankles with regular shoe laces. In many cases the T straps may not be necessary, but they tend to prevent recurrence of the equinovarus deformity.

The advantages enumerated by the authors are these: 1. It can be applied to the shoes so that the corrective effect received with weight bearing is continued during non-weight-bearing periods. 2. No projections are present under the surface of the splint, so that the patient can stand in his crib without harming the bed clothing. 3. Only one pair of shoes is required at a time, which is important economically, since the shoes can be used for ordinary walking or standing when detached from the splint. 4. The splint is easily made and can be applied and removed in a few seconds.

Schmier [137] states that occasionally in spastic paraplegia the intrinsic muscles of the foot are involved, producing a hyperactivity of the intrinsic muscles with extreme flexion of the toes at the metatarsophalangeal joint and extension of the interphalangeal joints. The anatomy and intrinsic muscles of the foot innervated by the medial and lateral plantar nerves are described. Histories of 2 cases are given in which the operative technic is discussed in detail (neurotomy of the motor branches of

135. Whitesell, F. B.: A New Instrument and a Simplified Technic for the Cure of Ingrown Nails, Surgery **18**:660-661 (Nov.) 1945.

136. Chatterton, C. C., and Blaisdell, J.: A Modification of the Denis Browne Splint, J. Bone & Joint Surg. **27**:518-519 (July) 1945.

137. Schmier, A. A.: Spastic Calcaneocavus Foot Deformity, Am. J. Surg. **68**:116-119 (April) 1945.

the medial and lateral plantar nerves; incision of the plantar fascia near the os calcis; the Steindler stripping of the os calcis, and section of the tendons of the flexor brevis tendons with plantar capsulotomy of the first metatarsophalangeal joint).

[Ed. Note.—It has been our experience that this usually occurs along with the equinus, and of course the equinus would lead to cavus deformity. Therefore it is not unusual to have to correct a cavus deformity in a spastic child.]

According to Woodland,[138] foot collapse is caused by overload or relative weakness of the foot. From the author's experience the commonest causes of functional insufficiency are the intrinsic factor of an unstable first metatarsal and the intrinsic factors of bad footwear, atonia of muscle and bad posture. The chief signs of full collapse of the foot are valgus at the heel, splay foot, supination of the forefoot, hallux valgus and contracted toes. The author shows in detail in his interpretation why once any of these signs appear the other signs can and will follow.

The foot is treated as a whole: Posture is corrected to achieve the optimum line of gravity. Rest, manipulation, contrast baths and faradic baths are used to get the foot in condition for foot and walking exercises, to be performed twice daily for several months. The corrective shoe with a Hauser bar and a Thomas heel is used. If the first metatarsal is extremely inefficient, a "platform" on the inner sole beneath the head of the first metatarsal is used. Surgical measures are sometimes used as indicated. A Whitman brace is used in severe arthritis of midtarsal and subastragaloid joints.

Meyer[139] considers flatfoot a symptom of inherited weakness of connective tissue. He states the belief that latent thrombophlebitis in the deep veins of the leg and of the plantar veins plays the deciding role in the causation of painful flatfoot.

[Ed. Note.—We think that the venous changes are secondary.]

For rigid arch supports, Street[140] recommends plexiglass, because of its durability, lightness, malleability and resistance to moisture. It is shaped to a plaster mold. A 3/16 inch (0.48 cm.) plexiglass is suggested for adults and a 1/8 inch (0.32 cm.) for children.

Hauser[141] states that the commonest lesion of the subtalar joint is a displacement of the calcaneus laterally or a valgus deformity, due to

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138. Woodland, L. J.: Foot Collapse, M. J. Australia **2**:562-565 (Nov. 25) 1944.

139. Meyer, O.: A New Treatment for Flatfoot and Other Common Foot Disabilities, M. Rec. **157**:732-733 (Dec.) 1944.

140. Street, D. M.: Plexiglass Arch Supports, Air Surgeon's Bull. **2**:109 (April) 1945.

141. Hauser, E. D. W.: Management of Lesions of the Subtalar Joint, S. Clin. North America **25**:136-160 (Feb.) 1945.

an imbalance between the demand made on the foot and the capacity of the foot to carry out the work required of it. This is the ordinary valgus deformity seen in pes valgoplanus as a result of prolonged strain on the foot. The retention of this position alters the relationship of the two articular surfaces of the subtalar joint. This position will cause a strain on the ligaments in this area and set up an inflammation within the articulation itself.

The principle of treatment consists in a realinement of the subastragalar articulation. This is done by placing the heel in varus and the anterior part of the foot in pronation, so that the inner side of the anterior part of the foot is at a lower level than the outer side. This position reestablishes the normal relationship in the subastragalar joint and maintains a normal height of the longitudinal arch. This normal weight-bearing position of the foot is retained with adhesive strapping, by felt pads in the shoes and/or by application of an inside lift to the heel and an outside lift to a comma-shaped bar on the sole of the shoe placed just posterior to the heads of the first four metatarsal bones. Walking with the foot in the aforementioned position is the most practical exercise. With reestablishment of proper gait, which consists in pulling oneself as tall as possible, keeping the feet straight ahead and placing the heel on the ground, with the foot in dorsiflexion, the patient rolls over the entire heel and gradually over the outer side of the foot and then pushes off the ground with the toes at the termination of the step. Habitual use of this gait insures retention of the subastragalar joint in a normal position and avoidance of symptomatic ligamentous strain and secondary arthrosis from malposition of this joint. Walking with this normal gait lessens fatigue and strengthens the muscular support of the foot, which increases the capacity of the foot for additional work.

Subtalar lesions due to anterior poliomyelitis result in instability of this joint due to loss of muscular support. An arthrodesis of the subtalar, talonavicular and calcaneocuboid articulations stabilizes the subtalar joint, prevents valgus position of the heel and eliminates the use of a brace.

Subtalar lesions due to fracture of the calcaneus produce disability because of the valgus position in the subtalar joint, with resultant pain and muscle spasm. Restoration of a normal position at the subtalar joint and of the anterior part of the foot which permits normal function also relieves pain. Fusion of the subtalar joint in a valgus position does not relieve pain. The principles and type of treatment following fractures of the calcaneus are similar to those for subtalar lesions due to static changes. The author reports asymptomatic conditions following fractures into the subtalar articulation and relief of pain secondary

to the valgus position of the subtalar articulation complicating these conditions after the valgus position is corrected and pain is relieved, including 1 instance in which complete bony fusion existed in the subtalar articulation. This last case demonstrates that the cause of pain is not secondary to post-traumatic arthritic changes in the subtalar articulation. Roentgenograms and drawings demonstrating the use of the Haglund foot board and a manipulating wrench to obtain supination of the anterior portion of the foot and positions of the foot in casts accompany the article.

Fracture of the talus often disrupts the normal relationship of the bones and articular surfaces in the foot, producing friction rub, irritation, inflammation and arthrosis. Treatment requires reestablishment of the normal relationship of the articular surfaces in the same manner as fractures of the calcaneus that involve the subtalar joint. Lesions of the subtalar joint due to dislocation at the talocalcaneal joint are treated in a similar manner after reduction.

Lesions of the subtalar joint due to tuberculosis, chronic infectious arthritis and 1 case with an unknown causation are discussed. (The foregoing article was abstracted by Dr. Robert P. Montgomery.)

Haxton [142] writes that absolute muscle force is regarded as tension per unit of cross section of the muscle and is not dependent on the length. For these experiments force of plantar flexion was noted by upward pressure on the ball of the foot. Rapid readings were made by the use of the spring balance in the living subject. The physiologic cross section was determined in the cadaver of the calf muscles, and the results were compared with those of living subjects by direct ratio of the diameter of the calves of the living and cadaver subjects.

In his paper on recurrent dislocation of ankle due to rupture of the external lateral ligament, I believe that Hambly [143] refers to subluxation of the ankle joint due to poorly treated torn external lateral ligaments. He repairs the ligament by splitting the peroneus longus tendon from above downward. One end is detached and threaded through the lateral malleolus to be fastened to the os calcis and then back again to be fastened onto itself, thus forming a new ligament.

[ED. NOTE.—This is another technic for repairing this ligament. In most cases we feel that the weakness should not exist with proper care, and frequently with conservative treatment, by increasing the capacity of the foot and the strength of the muscles that control the foot, all the symptoms will be relieved.]

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142. Haxton, H. A.: Absolute Muscle Force in the Angle Flexors of Man, J. Physiol. **103**:267-273 (Dec. 15) 1944.

143. Hambly, B.: Recurrent Dislocation of Ankle Due to Rupture of External Lateral Ligament, Brit. M. J. **1**:413 (March 24) 1945.

Simon [144] states that in order to obtain an oblique roentgenographic view of the lower part of the fibula a special exposure is necessary. In figures shown, the lateral malleolus is on the side of the roentgenogram; the heel is raised 4 cm., and the picture is made with the central ray directed from behind at an angle of 30 degrees.

Piatt [145] discusses the etiology and chemistry of para-articular calcifications as well as the anatomy of the ankle joint. Serial roentgenograms serve to explain and aid in making a final diagnosis. There are two types of calcification: evolutive, which appears fuzzy and has hazy margins with varying degrees of opacity in the adjacent connective tissues, and tibialis, which is a mature, contracted, well defined density.

Treatment is conservative: immobilization and physical therapy. Sedation may be employed for pain. In instances of severe conditions, anesthetic injections have been used, with good results. Irradiation therapy also has been used, with favorable results. In most cases full function of the ankle is never restored, and calcification may persist and be followed by fusion. Although there have been reports of cases of spontaneous regression of calcium, they are rare.

Injection of Procaine Hydrochloride.—Pendergrass and Lafferty [146] describe a type of dislocation of the ankle in which the usual anteroposterior and lateral roentgenograms appear normal. It is due to rupture or stretching of the external lateral ligaments of the ankle joint and is demonstrable in anteroposterior roentgenograms of the ankle in forced inversion, showing widening of the tibioastragalar joint space. Roentgenograms of normal ankles in inversion, eversion, flexion and extension are shown for comparison. The examination to determine mobility of the joint should be reserved as a supplementary procedure and not employed as a routine.

The manipulation of the joint is less painful for the patient if 5 or 10 cc. of procaine hydrochloride is injected around the point of maximum tenderness, although this is not essential. This type of examination is indicated in patients with a recurrent ankle sprain without severe pain, in those with a history of instability of the ankle, in those with abnormal motility of the ankle joint with a hollow instead of a swelling anterior to the external malleolus and in all patients with clinical symptoms suggesting more than a simple sprain in whom no evidence of bony injury can be found in the routine anterior, posterior and lateral roentgeno-

144. Simon, R. S.: A Third Routine X-Ray Exposure of the Ankle Joint, J. Bone & Joint Surg. **27**:520 (July) 1945.

145. Piatt, A. D.: Post-Traumatic Para-Articular Calcifications and Ossifications of the Ankle, Am. J. Roentgenol. **54**:348-354 (Oct.) 1945.

146. Pendergrass, E. P., and Lafferty, J. O.: Roentgen Study of the Ankle in Severe Sprains and Dislocations, Radiology **45**:40-44 (July) 1945.

grams. Any severe sprain that is to be treated by injection of procaine hydrochloride should also have this type of examination because of the possibilities of an unstable ankle if the external lateral ligaments are torn and not treated by immobilization.

McLaughlin [147] describes his method of infiltration of procaine hydrochloride in the treatment of acute sprains. Through a skin wheal, a long intramuscular needle being used, all tender areas about the ankle joint are thoroughly infiltrated with 20 cc. of a 1 per cent solution of procaine hydrochloride without epinephrine at each site. On completion of the injections, the ankle is gently massaged and manipulation of the joint is undertaken. The foot is carried into all positions, and if discomfort persists the injection is repeated. With satisfactory injection there is immediate relief of pain. The author reports that excellent results were observed following primary infiltration of procaine hydrochloride in nine tenths of the 51 cases seen within twenty-four hours after the injury occurred. The principal factors which may prevent this method from being successful are delayed injection, inadequate injection and extensive ligamentous damage.

Lewin [148] states that in trouble with the ankles and feet the patient is interested in discomfort, disability and deformity. The normal and abnormal mechanics and anatomy of the foot are discussed by the author. Disturbances of the foot are divided into numerous subdivisions, and various etiologic factors are enumerated. The Thomas heel and metatarsal crescent are discussed. Lewin attributes a common cause of metatarsalgia to a person sitting with weight resting on the toes and inverting the arch. Hallux valgus, bunions and the McBride operation are discussed briefly. A brief statement with illustrations is presented on calcaneal spurs, gout, pes cavus, Morton syndrome, sesamoiditis, bursitis, epiphysitis, cyst of the os calcis, gonococcic arthritis and gunshot wounds. The Gibney strapping is mentioned and recommended. Roentgenologic examination of a sprained ankle with the foot inverted following injection of procaine hydrochloride is advised.

Scott [149] expresses the opinion that the essential principles in the treatment of sprained ankles are adequate support and early weight bearing. The military boot, laced tightly and padded with felt, makes an ideal dressing for sprained ankles. Saddle felt ⅜ inch (0.96 cm.) thick, cut in circular pieces 3½ inches (8.8 cm.) in diameter and shaved

147. McLaughlin, C. W., Jr.: Procaine Infiltration in Treatment of Acute Sprains, Mil. Surgeon **97**:457-460 (Dec.) 1945.

148. Lewin, P.: Painful Conditions of the Foot and Ankle, Especially Those Due to Injuries, Proc. Interst. Postgrad. M. A. North America (1944), 1945, pp. 22-25.

149. Scott, W.: Sprained Ankles—A New Form of Treatment, U. S. Nav. M. Bull. **45**:679-684 (Oct.) 1945.

off on one side, is applied to the inside of the shoe so that the center of the pad corresponds to the "center" of each malleolus. A ¼ inch (0.64 cm.) strip is applied to the tongue. The support should be used for at least three weeks to insure healing.

Hipps [150] writes that ligamentous stretching is considered as the basic and major cause of persistent pain in all overused feet, if cases of infectious, degenerative, metabolic and gross trauma are excluded. Most of the pain in pes cavus is due not to stretch of the ligaments but to bruising of the soft tissue under the rigid metatarsal heads; injections of procaine hydrochloride therefore probably would be of no value. A valgus or planus foot condition of such a degree as to be incorrectable by conservative orthopedic measures is not a suitable condition, since spraining of the supporting ligaments will readily recur on resumption of heavy activity. Ambulation during recovery implies rather moderate activity, which does not place enough strain on the ligaments to prevent their healing. The ligaments not only should heal but should hypertrophy and become stronger during the process, a natural physiologic response to the increased demands on the foot. Loss of muscle tone and strength during ambulation is minimal.

The injection treatment of flatfeet and allied conditions is done by the injection of procaine hydrochloride through the sole of the foot into the painful site and the continuation of moderate ambulatory activity while recovery is occurring. The injections, followed by a period of walking, are repeated every third day. Usually after the second injection the patient expresses a desire to return to duty. On discharge from the hospital the patient is given a note requesting two weeks' light duty. Valgus abnormalities were treated the first day by the usual alterations of shoes supplemented with physical therapy, muscle exercises and instructions as to how to stand and walk. Adhesive strapping was discontinued because it limits natural movements of the foot. The author states that treatment by injection as described has reduced the number of hospital days per patient, decreased the number of "survey" cases, increased the number of men returning to duty, decreased the number of recurrences and, surprisingly enough, even decreased by about 50 per cent the number of patients admitted to the hospital for pain in the feet.

[Ed. Note.—Accompanying the reprint was a comment by the author saying that he doubted the value of this method of treatment in private patients of civilian life. This is not in accord with our experience. We have found the injection of procaine hydrochloride of considerable value in the treatment of painful feet due to functional decompensation in civilians.]

150. Hipps, H. E., and Neely, H.: The Injection Treatment of Flat Feet, U. S. Nav. M. Bull. **44**:262-266 (Feb.) 1945.

VI. CONGENITAL DISLOCATION OF THE HIP

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SCHNEIDER [151] describes the anatomy of a congenitally dislocated hip in a child of 13 months who died of pneumonia. Retardation of normal development was manifest in delayed appearance of epiphysial nuclei in the upper and lower extremities. This report constitutes further proof of the etiologic significance of hypoplasia of the joint ends of the bones. Ordinary muscle tone will then have sufficient force to cause a luxation. In the presence of slight hypoplasia the joint may develop normally, but the addition of some exogenous factor may cause dislocation. The earliest date for dislocation is during the third fetal month. The higher incidence of dislocation of the left hip is attributed to factors governing the generally less decided development of left-sided structures.

Heidsieck [152] describes a case of voluntary dislocation in a girl 2 years of age, which was observed accurately by means of the roentgenogram. He states that he has already described 1 other similar case and that Hilgenreimer has reported 2 cases. In this case dislocation occurred almost exclusively at night. Immobilization of the hip at night sufficed to prevent the luxation.

Schrader [153] reports the case of a 9 month old girl in whom roentgenograms revealed a dislocation of the hip and hypoplasia of the femoral head. Two and one-half years later roentgenograms showed a spontaneous cure, no dislocation was present and the size and shape of the femoral head were almost identical with those of the normal hip.

Perkins [154] summarizes the facts and opinions generally known concerning the subject of congenital dislocation of the hip. The report contains no observations original with the author. This paper was, apparently, written for the benefit of the medical student and the general practitioner.

Schwartz [155] demonstrates that with a V-shaped plaster device reduction can be maintained. This type of cast consists of the following parts: casts applied to the legs from the hips downward and including the feet,

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151. Schneider, H.: Pathogenesis of Congenital Luxation of the Hip from the Point of View of Functional Anatomy, Ztschr. f. Orthop. **74**:201, 1943.

152. Heidsieck, E.: Dislocation of the Hip: Voluntary Subluxation in Young Children, Ztschr. f. Orthop. **74**:235, 1943.

153. Schrader, E.: Question of Spontaneous Cure of Congenital Luxation of the Hip, Ztschr. f. Orthop. **74**:311, 1943.

154. Perkins, G.: Congenital Dislocation of the Hip, Practitioner **155**:70-77 (Aug.) 1945.

155. Schwartz, R. P.: V Plaster Splint for Maintaining Reduction of Congenital Dislocation of the Hip, J. Bone & Joint Surg. **27**:166-167 (Jan.) 1945.

with hips maintained in flexion and abduction and knees and ankles flexed to a right angle, and a large V-shaped structure, with the ends of the two arms fastened to the feet and the angle of the V below. The casts with the V extension below them constitute a pentagonal figure. The pelvis is not enclosed in the cast. The casts do not become soiled with urine and feces. Rotation of the femoral heads within the acetabulums is permitted, and the child can sit up or lie on his face or back without recurrence of the dislocation.

(To Be Continued)

REVIEW OF UROLOGIC SURGERY

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KIDNEY

Anomaly.—Harrison and Botsford [1] review a group of 72 cases of congenital anomalies of the kidney. Twenty-one patients required operative surgical intervention; seven of the operations were for calculi, and fourteen were for congenital hydronephrosis. Forty patients were returned to full military duty and 6 to limited duty, and 25 were evacuated to the United States. One patient died. Renal lithiasis, pyelonephritis and hydronephrosis were the conditions superimposed on the renal anomalies. It is thought, as a result of the study of these cases, that when such conditions complicate a renal anomaly the patient is not fit for tropical duty. Patients who require nephrectomy and the majority of those who need plastic procedure for hydronephrosis should, with rare exceptions, be evacuated to the United States. True renal ectopia, horseshoe kidney, other types of fused renal mass and polycystic disease are considered as contraindications to overseas service.

Nephroptosis.—Burford [2] states that the commonest and usually the first symptom of nephroptosis is pain, which the patient experiences after he becomes tired or stands for long periods. The pain may be in

1. Harrison, J. H., and Botsford, T. W.: Experiences in the Management of Congenital Anomaly of the Kidney in the Army, J. Urol. **55**:309-322 (April) 1946.

2. Burford, C. E.: Nephroptosis with Co-existing Lesions, J. Urol. **55**:220-224 (March) 1946.

the posterior fossa, under the twelfth rib or on either side of the abdomen, and it may extend to the genitalia and urethra. The second commonest symptom and one which accompanies the first is nausea or vomiting. Cases of extreme nephroptosis may occur in obese patients, but the majority of patients are thin, have lost weight and have relaxed abdominal walls. Often the kidney is only a part of a splanchnoptosis which includes a ptosed stomach, a transverse colon in the pelvis and a liver which comes to the level of the crest of the ilium when the patient is standing. If the position of the kidney and ureter causes urinary stasis and hydronephrosis, infection and formation of stones frequently become complications.

A diagnosis of low or movable kidney is not sufficient. In thin patients the kidney may be palpated as low as the pelvic brim, cause no distress and function perfectly in that position. Intervention in such a case is not justifiable. Complete urologic examination, with careful interpretation of the findings, is necessary before it can be predicted that nephropexy will relieve the patient's symptoms and stop the destructive process in the kidney itself. Use of the proper type of belts and corsets may relieve nephroptosis if they are properly adjusted, but it cures few patients. In many cases Burford prefers to have patients try a nonelastic abdominal girdle for a time, for they will be better pleased with their surgical results after this trial. In nephropexy Kelly's three point stitch in the renal capsule has proved satisfactory. The upper suture is brought out and tied in the intercostal muscles between the eleventh and twelfth ribs. The other two are sutured to the muscles and fascia in the back, under the twelfth rib. Care must be taken not to rotate the kidney out of its normal plane.

Burford's conclusions today are essentially the same as those which he drew eighteen years ago, when he reported his first 48 cases, although much improvement has been made on the plastic procedures at the ureteropelvic juncture. Nephropexy affords permanent relief when ptosed kidneys cause pain and destructive processes. Ureterolysis and plastic procedures on the pelvis are necessary in a large percentage of the cases. It is a safe operation, with a mortality rate of less than 1 per cent. Use of abdominal belts and corsets may give relief but does not cure the condition. Persistent infections in the ptosed kidney may be cured in many cases only by nephropexy which will insure perfect drainage.

Tumors.—Wilms's tumor in the great proportion of cases develops in infants and children, and rarely in adults. Twinem [3] reports a case of a 75 year old man, who is thought to be the oldest patient on record in whom Wilms's tumor has occurred. The entire ureter and the

3. Twinem, F. P.: Wilms' Tumor in Seventy-Fve Year Old Male: Report of a Case, J. Urol. **55**:246-251 (March) 1946.

ureterovesical orifice were involved with the tumor. The general histologic picture was that of tubules embedded in spindle cells, both elements being neoplastic. The tumor tubules were formed by atypical cells, which were frequently more than one layer thick. Cartilage was present. In one section a pale-staining mucoid matrix was noted. Hyperchromatism was distinct in all parts of the tumor. No striated muscle was found.

The treatment of Wilms's tumor is prompt surgical removal, preceded, when reduction in size is important, and followed, in most instances, by irradiation. When the age of the patient and other factors in this case are considered, postoperative roentgen treatment did not seem to be indicated.

Crabtree[4] states that either benign or malignant tumors of the smooth muscle of the kidney of surgical import are extremely rare. The outstanding peculiarities are distribution beneath the renal capsule, smoothness of texture and a tendency to be associated with cysts. When associated with cysts they appear to lie within the cyst cavity. The size of the tumors, if large, or the presence of the cysts in which they lie may suggest the diagnosis of renal tumor, but grossly they present no characteristic appearance to distinguish them from other tumors or cysts. The tumor tends to show cystic degeneration itself, and, microscopically, cystic tubules can be found. The tumors appear to occur in young adults. They tend to be encapsulated and, if malignant, appear to be curable by nephrectomy. Because of the necessity for pathologic examination to determine whether the tumor is malignant, nephrectomy is the procedure to be employed, at least until the clinical characteristics and their significance are known.

Calculi.—Cook[5] and Keating[5] discuss renal calculi associated with hyperparathyroidism. They state that hyperparathyroidism is an important and relatively frequent cause of renal calculi and that the appreciation of this fact will reduce the number of patients who suffer from recurrent calculi and subsequent serious renal damage.

They made an intensive search in cases at the Mayo Clinic for evidence of hyperparathyroidism, particularly among patients having renal calculi as their chief complaints, and during eighteen months 18 proved instances of hyperparathyroidism were recognized. In 4 of these cases the patients had only the classic disease of the bone, and in 14 cases the patients had associated renal calculi.

Even should it ultimately be shown that hyperparathyroidism develops in only 5 per cent of all cases of renal calculi, it is worth while

4. Crabtree, E. G.: Leiomyoma of the Kidney Associated with Hemorrhagic Cyst, Tr. Am. A. Genito-Urin. Surgeons **37**:245-255, 1944.

5. Cook, E. N., and Keating, F. R., Jr.: Renal Calculi Associated with Hyperparathyroidism, J. Urol. **54**:525-530 (Dec.) 1945.

to investigate the possibility in all cases in order to give the patients the advantage of a correct diagnosis. Cook and Keating are of the opinion that in cases of recurrent or multiple calculi the greatest opportunity for establishment of the diagnosis of hyperparathyroidism is afforded. It is generally recognized that approximately 10 per cent of patients who have urinary calculi removed will have a recurrence of the calculi, and the authors express the opinion that this percentage can be reduced appreciably if patients who have hyperparathyroidism are carefully excluded. They present a routine for the diagnosis of hyperparathyroidism, the diagnostic criteria being hypercalcemia, hypophosphatemia, hypercalciuria and hyperphosphaturia.

Tuberculosis.—Suter [6] injected into 65 guinea pigs material obtained from sixty-five of two hundred and forty healthy kidneys which remained after nephrectomy was performed for tuberculosis. The results were positive in 25 per cent of the sixty-five tests. In 15 per cent of the 240 cases slight albuminuria was present, and in 10 per cent a few leukocytes were found in the urine. In one half of the 240 cases tuberculosis of the remaining kidney later developed. When results of inoculation of a guinea pig indicated that tuberculosis was present and leukocytes were found in the urine, usually tuberculosis developed in the remaining kidney later.

Polycystic Disease.—Young [7] suggests the use of sclerosing solutions after surgical exposure in treatment of polycystic kidneys. An unusual case of rapid, unilateral renal enlargement occurring in a young girl with polycystic kidneys is presented. Treatment consisted in aspiration of the cysts followed by instillation of 5 per cent solution of sodium morrhuate into large individual cysts after renal exposure. Preoperative intravenous use of indigo carmine is recommended as a necessary precaution to diminish the possibility of injury to the renal pelvis. Theoretic merits of the procedure are discussed.

URETER

Transplantation.—Dodson [8] states that ureterovesical anastomosis is the most desirable disposition of the ureter when it has been severed accidentally or must be divided near its terminal portion. In resection of a portion of the bladder for malignant disease, when the orifice of the ureter is involved, the ureter may be reimplanted into the bladder, with considerable assurance of permanent preservation of the function of the

6. Suter, F.: Die Feststellung der Gesundheit der einen Niere bei der Nierentuberkulose, Schweiz. med. Wchnschr. **76**:125-126 (Feb. 16) 1946.

7. Young, W. W.: Sclerosing Injection of Polycystic Kidney Following Surgical Exposure, J. Urol. **55**:323-329 (April) 1946.

8. Dodson, A. I.: Some Improvements in the Technique of Ureterocystostomy, J. Urol. **55**:225-237 (March) 1946.

kidney. The same is true when the ureter has been injured or its function impaired by disease sufficiently near the bladder to permit the operation to be performed without tension on the ureter.

The ureter can be transplanted successfully either transperitoneally or retroperitoneally. In the transperitoneal operation, the peritoneum should be accurately sutured over the ureter and extraperitoneal drainage should be provided to the area of implantation. Transperitoneal implantation is the natural procedure when an injury of the ureter is discovered at the time of a pelvic operation. When the operation is done exclusively to reimplant the ureter into the bladder, the extraperitoneal approach has several advantages. The ureter is more easily exposed and liberated. Both the ureter and the portion of the bladder presenting the most desirable location for reimplantation are normally extraperitoneal. Retroperitoneal drainage is more easily instituted, and the danger of disastrous results from leakage or infection is less.

The site of implantation and the way in which the ureter is made to traverse the vesical wall depend, to some extent, on the length of ureter available and in vesical resection on the amount of bladder that must be removed. The implantation should be made into the base of the bladder, near the original ureteral orifice, when possible. Angulation at the point of entrance is less likely to occur, and subsequent catheterization, if indicated, will be less difficult. The ureter should be implanted near the top of the bladder only when it is necessary to prevent tension at the point of union.

Mobilizing or straightening the ureter lengthens it and lessens the distance that it must traverse to reach the bladder. The additional length of ureter made available by this procedure is considerable. This is particularly true when the ureter has become dilated and tortuous because of partial obstruction, which often occurs after disease or fistula at the lower end of the ureter. Furthermore, the ureter describes a considerable arc as it curves outward and backward along the surface of the true pelvis. This arc can be straightened to a considerable extent without interfering with the function of the ureter. The abundant blood supply and the free anastomosis of the ureteral blood vessels make it possible to free the ureter almost completely without danger of necrosis. The ureter is endangered only when the loose fibrous coat is stripped away.

In Dodson's experience the following operation gave the most satisfactory results: An incision is made beginning just above and about 2 inches (5.1 cm.) medial to the anterior spine of the ilium and extending downward and inward parallel to Poupart's ligament. The peritoneum is separated from the posterior part of the abdominal wall by blunt dissection from above the brim of the pelvis down to the bladder and medially to the spine. As the peritoneum is retracted medially, the iliac vessels are exposed and the ureter can be seen as it passes over these

vessels and can be traced along the posterior surface of the peritoneum. The ureter is freed from the peritoneum from well above the iliac vessels downward to the fistula or, in ureteral disease, to the bladder. In women, if the ovarian vessels interfere with liberation and exposure of the lower end of the ureter, they may be ligated and divided. The ureter is then divided just above the fistula or the diseased area. The lower stump is ligated or excised according to indications. An incision about an inch (2.5 cm.) long is then made in the posterior wall of the bladder, extending from above downward as near the original ureteral entrance as possible. The incision extends to, but not through, the mucosa, which is carefully dissected from the muscles of the bladder for a short distance on both sides of the incision. The mucous membrane of the bladder is then incised at the lower end of the incision; a thin-bladed hemostat is inserted into the bladder, and the end of a catheter, previously passed through the urethra, is grasped and pulled through the incision. The end of the ureter is beveled, and a small soft rubber catheter, which has had the end cut off and two small holes made in the sides near the end, is inserted into the ureter for 3 or 4 inches (7.6 or 10.2 cm.). A suture of 00 plain surgical gut is passed through the tip of the beveled ureter and tied snugly to the catheter. The distal end of this catheter is then sutured to the tip of the bladder catheter, which is withdrawn, the end of the catheter in the ureter being pulled out through the urethra. Fixation sutures are taken through the superficial tissues of the ureter on each side about 1 inch (2.5 cm.) from the beveled tip. Both ends of these sutures are threaded on a small curved needle. The point of the needle is passed through the incision and the vesical wall from within outward. As traction is made on the catheter, the ureter is pulled into the bladder until the area pierced by the sutures enters the incision into the bladder. The sutures are drawn taut and tied on the outside of the bladder as mattress sutures. With the small catheter in the urethra and a large catheter placed suprapubically, complete drainage and absolute immobilization are assured. When the length of the ureter does not permit a submucous implantation, the operation differs only in that the ureter enters the bladder through a short incision directly through the vesical wall.

Cancer.—McClelland[9] reports a primary carcinoma of the ureter treated by excision and anastomosis of the cut ends. The patient, a man aged 62 years, complained of hematuria. An intravenous pyelogram indicated the presence of hydronephrosis on the right side. On cystoscopy, a stricture was found on the lower end of the right ureter. Surgical exploration of the right ureter was performed, the lower

9. McClelland, J. C.: Primary Carcinoma of Ureter Treated by Excision and Anastomosis of the Cut Ends, Tr. Am. A. Genito-Urin. Surgeons **37**:159-164, 1944.

end of the ureter which contained a new growth was resected and anastomosis was carried out. The pathologic report and diagnosis of the tumor were papillary carcinoma.

O'Conor,[10] in discussing McClelland's paper, objects emphatically to local excision of any tumor of the ureter. During the past twelve years he has operated on 8 patients with primary papillary tumors of the ureter. In all the cases he performed complete nephroureterectomy and resection of a generous portion of the wall of the bladder. No evidence of recurrence of tumor has been found, and all the patients are living and well.

One patient who, about fifteen years ago, underwent an operation in which the kidney and all the ureter except the intramural portion were removed, died three years later of recurrence of the tumor in the vesical wall and intramural portion of the ureter.

Six of O'Conor's patients had undergone partial excision of the ureter and kidney for tumor of the ureter elsewhere. In all these cases recurrence of the tumor occurred in the ureteral stump, and in 2 it occurred in the bladder. Three of these patients had low grade tumors, and, after removal of the ureteral stump and a cufflike portion of the vesical wall, the tumors did not recur. The other 3 patients have died as the result of metastasis of the tumor. These experiences emphasize that the curability of primary tumors of the ureter is directly dependent on complete surgical removal of the entire urinary tree on the involved side at the time of the original diagnosis.

Incontinence.—Greene and Ferris,[11] in a discussion of urinary incontinence due to bilateral ectopic ureters, state that a correct diagnosis of ectopic ureter will enable the physician to achieve a brillant cure by the proper surgical procedure, usually heminephrectomy. Female patients, miserable as a result of urinary incontinence, can be restored to perfect continence, and male patients can be relieved of intractable urinary infection by proper diagnosis and surgical treatment. If incontinence persists among female patients after unilateral heminephrectomy, bilateral ureteral ectopia is suggested and further urologic investigation of the opposite kidney, including exploration if necessary, is indicated.

Postcaval Ureter.—Lowsley [12] states that postcaval ureter is a rare anomaly. His case was the thirty-fourth to be reported in medical literature. This is an anomaly of the embryonic vascular system rather than of the urinary system, because it results from faulty development of the inferior vena cava. The preureteric vena cava is usually associated with other anomalies of the retroperitoneal veins. Of the 34 reported cases,

10. O'Conor, V. J., in discussion on McClelland,[9] pp. 187-188.

11. Greene, L. F., and Ferris, D. O.: Urinary Incontinence Due to Bilateral Ectopic Ureters, Surg., Gynec. & Obst. **82**:712-716 (June) 1946.

12. Lowsley, O. S.: Postcaval Ureter, with Description of a New Operation for Its Correction, Surg., Gynec. & Obst. **82**:549-556 (May) 1946.

the condition was discovered in 22 at postmortem examination or laboratory dissection, in 11 (including Lowsley's) at operation and only in 1 preoperatively.

Postcaval ureter may be present without producing symptoms. Symptoms, when present, are those of ureteral obstruction, which may be produced by pressure exerted by the vena cava on the underlying ureter or by kinking or stricture due to the anomalous course of the ureter. Stereoscopic roentgenograms taken with the patient in the anterior, posterior and oblique positions aid in the diagnosis. The roentgenologic appearance is distinctive in the following respects: 1. In an oblique roentgenogram the portion of the ureter dorsal to the vena cava will impinge against the lower lumbar portion of the spinal column, whereas the normally situated ureter will fall away from it. 2. The postcavally placed ureter always is displaced toward, at or even beyond the midline of the body. The ureter, winding around the vessel, forms a sickle-shaped curve, with the convexity directed supermedially. Severe damage to the kidney in these cases may necessitate nephrectomy. Otherwise, corrective surgical treatment, namely, transference of the ureter from behind the vena cava to its normal position in front of the vessel, is the treatment of choice. Only 4 cases in which corrective surgical treatment was given were reported previous to Lowsley's. In 3 of these, the ureter was divided and the upper portion was anastomosed; in 1, the division and anastomosis were above the ureteropelvic junction.

The operation described aims at the preservation of the intrinsic nerve supply to the ureter and correction of the anomaly. The ureter is severed at its point of entry into the vesical wall, removed from behind the vena cava and placed in normal position, and the end is reimplanted into the vesical wall.

PROSTATE

Cancer.—Huggins [13] discusses prostatic cancer treated by orchiectomy and gives the five year results. His first series was composed of 21 consecutive patients presenting far advanced prostatic cancer as defined by the presence of demonstrable metastatic lesions or local infiltration considerably beyond the prostatic capsule. One patient died of pneumonia eight days after operation and was excluded from the study. Fourteen patients had roentgenographic evidence of osseous metastasis. Irradiation was not employed, and estrogenic substances were not administered until it was obvious that a relapse had occurred.

In 2 cases no obvious benefit was derived from orchiectomy, while in the remaining 18 cases alleviation of clinical symptoms occurred for varying periods. In this group of 20 senile men, 2 died as the result of intercurrent disease. Eleven patients (55 per cent) died in the first two

13. Huggins, C.: Prostatic Cancer Treated by Orchiectomy: The Five Year Results, J. A. M. A. **131**:576-581 (June 15) 1946.

years after orchiectomy, and 4 patients died in from thirty-six to sixty-three months. The duration of life in the 15 cases in which death occurred was from three and a half to sixty-three months, and the median survival time was sixteen months. The duration of the remission of symptoms in these cases was three and a half to fifty-seven months, and the median duration of improvement was eleven months. The prostate was soft, small and atrophic at postoperative clinical examination in 4 of these 15 cases, while the growth of metastatic lesions was flourishing in bone marrow and lymph gland. Five patients survived more than five years after orchiectomy; 1 man is in good health but has a mass of tumor tissue the size of a hen's egg in the region of the seminal vesicle. No sign of disease can be detected in 4 patients. These 4 patients had evidence of widespread metastasis to bone and an elevated level of serum phosphatase at the time of orchiectomy; in each case, after five years the enzyme levels were within the normal range and the bones showed equivocal or no evidence of metastasis.

The early evidence of clinical improvement after orchiectomy includes the relief of pain, improved appetite, gain in weight, decrease of anemia and decrease of size and sometimes disappearance of the primary tumor and of the metastatic lesions. Occasionally an untreated patient who has prostatic cancer will live for more than five years; however, in such cases the tumor does not regress but grows slowly. An explanation for prolonged survival in those cases must be spontaneous androgenic deficiency through accidental physiologic failure of androgen production. It is still impossible to predict the course of the disease after orchiectomy at this time.

Hypertrophy.—Schaffhauser [14] reports 313 cases in which perineal prostatectomy was performed. The total mortality rate was 3.8 per cent. The original method of Wildbolz was modified at two points: 1. The prostatic capsule was opened by a bow-shaped incision, according to the method of Kirschner, to avoid damaging the external sphincter. 2. After enucleation of the prostatic adenoma, the prostatic capsule was included in the urethrovesical suture. Spinal anesthesia administered according to the method of McGill proved to be the most satisfactory anesthesia. The perineal wound closed within fourteen days in 76 per cent of the cases. Hemostasis carried out according to the usual method reduced bleeding to a minimum. Severe postoperative hemorrhage occurred in only two of three hundred and twenty-seven perineal prostatectomies, including fifteen extracapsular operations for carcinoma of the prostate. In general, Schaffhauser is of the opinion that too much importance is attached to the danger of damaging the rectum and to the

14. Schaffhauser, P.-D. F.: Ueber Technik und Resultate der perinealen Prostatektomie bei Prostatahypertrophie, Helvet. chir. acta **12**:577-600 (Dec.) 1945.

formation of fistulas, as well as to postoperative incontinence. These complications result from faulty surgical technic and can be prevented by use of a well proved method and by experience. Of all the cases in which operation was performed by Schaffhauser, total incontinence of urine occurred in 1 case. The nonmodified method of Wildbolz was used in that case. In 4 cases rectoperineal fistula developed and healed spontaneously. The formation of rectourethral fistula was never observed. A urethroperineal fistula occurred in 2 cachectic patients, who died shortly after operation. Perineal prostatectomy is superior to transvesical prostatectomy and is worthy of further generalization.

Lazarus [15] states that spontaneous hematuria is a frequent symptom among patients with prostatism and may vary from the presence of a few erythrocytes to the high power field (occult blood) to massive bleeding, which may at times assume alarming proportions. The former occurs much more frequently than does the latter. Bleeding may be due to mucosal ulcerations situated on the opposing surfaces of the lateral lobes, resulting from infection or friction, or it may be due to rupture of small or large varices in the prostatic urethra. In other instances, the bleeding may be due to conditions extrinsic to the prostate which are secondary to obstruction of the vesical neck, such as cystitis, calculi, hydroureter and hydronephrosis.

Cavitary Prostate.—Alfonso and Emilio de la Peña [16] state that cavitary or diverticular prostatitis was first referred to by Albarran and Janet. Credit should be given to Luys, of Paris, for having made a thorough study of this condition and for having proposed destruction of cavities by galvanic current applied through the urethroscope. The symptoms of cavitary prostatitis are the same as those of other chronic forms of prostatitis, that is, pus and shreds in the urine, hematuria, frequency of micturition, pain along the urethra and perineum and sexual symptoms. The diagnosis may be made by urethroscopic or urethrographic examination, the latter being the more accurate of the two methods. Transurethral destruction of cavities has been employed successfully in treatment. In some cases perineal prostatotomy may be indicated. Deep roentgen therapy has resulted in definite cure in a small number of their cases.

BLADDER

Tumor.—Rose [17] reports his results of treatment of carcinoma of the bladder with open roentgen therapy in more than 40 cases. The basic

15. Lazarus, J. A.: The Significance of Spontaneous Hematuria Associated with Hypertrophy of the Prostate, J. Urol. **54**:531-538 (Dec.) 1945.

16. de la Peña, A., and de la Peña, E.: Diverticular or Cavitary Chronic Prostatitis, J. Urol. **55**:273-277 (March) 1946.

17. Rose, D. K.: Open X-Ray Therapy in Carcinoma of the Bladder, J. Urol. **55**:267-272 (March) 1946.

principle has been, and still is, that vesical carcinoma of the invasive type is sufficiently similar to carcinoma of the skin that if direct exposure to roentgen rays could be applied as successfully to the bladder as they are to the skin certain desperate carcinomas of the bladder might be cured. The critical surgical points are removal of all redundant tissue and holding of the cancer-bearing area of the vesical wall taut and flat while treatment is given. It is necessary that the basement area of the carcinoma be presented as a flat surface to the target so that the roentgen rays can be distributed evenly over and through it.

A most important technical development that has improved Rose's statistics in the last few years is the removal of redundant tissue, bloody urine and blood clots from the surface of the tumor, so that the basement area of the tumor and its stretched adjacent vesical wall receive full benefit of the irradiation.

This form of treatment is used for invasive tumors only of the most desperate type. When the tumor involves the base or the side wall direct exposure can be given, but when the vesical outlet is invaded results are not satisfactory by this method. Even though the carcinoma is large or multiple and covers the floor and a lateral wall, results may be satisfactory.

In the early experimental stages of this work Rose used the treatment only in cases of extreme dysuria and toxicity caused by large infiltrative carcinoma of the bladder, in which definite evidence of metastasis was present. The relief gained by reduction of the dysuria warranted operation. In 3 such cases, although the patients died as the result of metastasis later, the bladder showed no malignant cells. After some time roentgen treatment was given in cases in which no evidence of metastasis was present and in which the choice of treatment was between cystectomy, implantation of radon seeds, closed roentgen therapy or open roentgen therapy. Later, invasive tumors not so large, yet which Rose considered of a desperate type, that is, those involving a ureteral orifice, the trigone, possibly 2 to 3 inches (5.1 or 7.6 cm.) or more across, were treated by this method. The results warranted further effort.

At first Rose used approximately 1,800 r twice. No difficulty was encountered in exposing the tumor at the second operation. It was by this method that his best early results were obtained. He now uses approximately 3,300 r in one treatment and anticipates immediate or "near term" favorable results in about 25 per cent of cases. His expectancy of cure of the vesical carcinoma but death of the patient from metastasis is somewhat higher.

Jewett and Strong [18] discuss the relationship of the depth of penetration of the wall of the bladder by infiltrating carcinoma of the bladder

18. Jewett, H. J., and Strong, G. H.: Infiltrating Carcinoma of the Bladder: Relation of Depth of Penetration of the Bladder Wall to Incidence of Local Extension and Metastases, J. Urol. **55**:366-372 (April) 1946.

to the incidence of local extension and metastases. They made an exhaustive survey of necropsy material. They collected 127 cases of infiltrating tumor of the bladder in which necropsy had been performed but were obliged to eliminate 20 cases because the pathologic material was not suitable for this particular study. They then undertook to determine in these 107 cases the relation of depth of penetration of the bladder wall to the incidence of (1) metastasis, (2) lymphatic capillary invasion (incipient metastasis) and (3) perivesical fixation.

First they separated the cases into three groups according to depth of penetration of the vesical wall. Group A comprised those in which tumor cells were confined to the submucosa. Group B consisted of those in which infiltration had extended into but not through the muscularis. Group C included all cases in which tumor cells had extended completely through the muscle coat. They then determined in each group the number of cases in which regional or distant metastasis had occurred,

Potential Curability of Infiltrating Carcinoma of the Bladder

	Group A (Submucosal Infiltration)	Group B (Muscular Infiltration)	Group C (Perivesical Infiltration)
Cases	3	15	89
Metastasis	0	1	52
Perivesical lymph only	0	0	6
Perivesical fixation	0	0	8
Potentially curable	100%	86.6%	26%

the number in which perivesical lymphatic or vascular invasion only had occurred and the number in which perivesical fixation of the mass was present. In each group the percentage of cases without these evidences of tumor spread gives them their figure for potential curability. The number of cases in groups A and B is small probably because at necropsy cases for the most part represent late stages of the disease. By the term "potential curability" they mean to imply only a theoretic possibility based on the exclusion of all gross and microscopic evidence of tumor spread, actual or incipient, beyond the confines of the vesical wall.

Of the 89 cases comprising group C, regional or distant metastasis was present in 52. The regional lymph nodes were the site of metastasis in 33 instances, the liver in 26, the lungs in 18 and the vertebral column, including the sacrum and pelvis, in 11. Other tissue was involved twenty times, but in only 7.7 per cent of the cases without involvement of lymph nodes, liver, lungs or bones. In 36.5 per cent of the cases in which evidence of metastasis was found, the regional lymph nodes were not involved.

In 26 per cent of the 89 cases in which tumor cells were present in the perivesical tissue, metastasis, lymphatic invasion and fixation had not

occurred. It, therefore, is evident that infiltration of the perivesical tissue and invasion of lymphatic vessels are not necessarily simultaneous. In the 19 cases in which surgical deaths occurred, metastasis was present in only 26 per cent, whereas in the group of late cases metastasis was present in 67 per cent. Lymphatic invasion and fixation to neighboring structures, however, brought the theoretic incurability in the first group to 63 per cent and in the second to 78.5 per cent, which is extremely high when compared with the low figure of 13 per cent for group B.

Scholl [19] reports a case of xanthoma and carcinoma in a diverticulum of the urinary bladder. A man aged 59 years had occasional attacks of urinary infection and hematuria. Cystoscopy revealed no urethral obstruction or prostatic hypertrophy. A grayish white, tumor-like mass in the bladder extended into a fairly large diverticular opening. Blood could be seen coming from the diverticular opening. At operation, a tumor mass could be felt in the diverticulum. The sac and a segment of the vesical wall containing the grayish white area were resected. On opening the diverticulum, two large papillary carcinomas were found. The grayish plaque which extended from the bladder up into the sac was a xanthoma. The other two separate tumors were papillary carcinomas of a high degree of malignancy. Healing progressed normally. A year later no evidence of recurrence was found.

O'Conor,[20] in discussing Scholl's paper on diverticulum of the bladder, emphasized one fact. The tendency on the part of urologists who perform transurethral prostatic resection in all cases to disregard the importance of diverticula of the bladder as a symptom-producing factor has been increasing. This disregard is becoming widespread and has been indulged in by many competent urologists, who advise leaving the diverticula and merely resecting the vesical neck. That this is good judgment in the case of small diverticula which drain freely is evident, but, if the diverticula are large and do not drain freely, one should be sure that the diverticulum is not the seat of stone or tumor.

Barringer,[21] in discussing Scholl's paper, reported 2 somewhat similar cases. One patient had had infection from the time that he was a college student until he was about 60 years old. This infection was caused by an enormous diverticulum, which extended to the diaphragm and could not possibly be removed. At that time multiple small infiltrating carcinomas were present all over the bladder. Barringer performed suprapubic drainage at one time late in the course of the disease. The patient died. The second patient had complete retention of urine. Cystoscopic examination was made, and it was found that he had an inflamed but

19. Scholl, A. J.: Xanthoma and Carcinoma in a Diverticulum of the Urinary Bladder, Tr. Am. A. Genito-Urin. Surgeons **37**:67-71, 1944.

20. O'Conor, V. J., in discussion on Scholl,[19] p. 84.

21. Barringer, B. S., in discussion on Scholl,[19] pp. 88-89.

otherwise normal bladder. Continuous catheterization was necessary for twenty years after this. Suprapubic drainage was then performed. At that time precisely the same condition was found as in the first case—"multiple tumors, small, infiltrating plaques all over the bladder." Obviously, in some way the infection must have been a contributory cause to the tumor.

Shivers [22] presents 2 cases of advanced infiltrative carcinoma of the base of the bladder in which bilateral subcapsular orchiectomy was performed. Striking alleviation of subjective symptoms and apparent retardation in the rate of the growth of the tumor occurred postoperatively. He suggests that orchiectomy may prove a valuable adjunct to other well established procedures.

Malacoplakia.—Cristol and Broders [23] report 2 interesting cases of malacoplakia of the bladder. The name "malacoplakia" (from the Greek word *malakos,* meaning "soft") was given to this pathologic change by von Hansemann in 1903. This disease is not limited to the bladder; it may also affect the ureters, renal pelves and renal parenchyma. Its importance rests in its recognition and differentiation from malignant change. The cause is unknown. Von Hansemann found clumps of bacteria resembling Escherichia coli in several of the lesions that he examined. Grossly or cystoscopically the characteristic lesions appear as plaques, which vary in number, size and distribution. There may be two or three, or there may be several hundred. In size they vary from nodules as large as miliary tubercles to confluent lesions measuring several centimeters in diameter. The plaques have a variable distribution and most characteristically are scattered over the entire mucous membrane. They appear as grayish yellow or yellow-brown, flat-surfaced areas. The majority of the patients are women more than 30 years of age who have had frequent bouts of cystitis. Urinary frequency and gross hematuria are the most prominent symptoms.

The cases of malacoplakia so far reported are too few for the treatment to be standardized. The authors agree with others in reporting fairly good results following fulguration. Removal of a source of infection, such as a diseased kidney and ureter in 1 case, was followed by the disappearance of the lesions with their attendant symptoms. Other authors have used local applications of potassium iodide and autogenous vaccines. Occasionally, excision of the lesions has been carried out when they were considered accessible.

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22. Shivers, C. H. deT.: Bilateral Orchiectomy in Advanced or Recurring Carcinoma of the Bladder with Severe Subjective Symptoms: A Preliminary Report, J. Urol. **54**:539-546 (Dec.) 1945.

23. Cristol, D. S., and Broders, A. C.: Malacoplakia of the Bladder: Report of Two Interesting Cases, J. Urol. **55**:260-266 (March) 1946.

Rupture.—Brooks [24] reports a case of traumatic rupture of urinary bladder in an infant 3½ months old, who recovered. Ashurst reports an analysis of 110 cases, in which the mortality rate was 42 per cent. Besley reported 23 cases at Cook County Hospital, in which there were 18 deaths and 5 recoveries, a mortality rate of 78 per cent. In Campbell's series of 55 cases the mortality was 35, a rate of 63 per cent. Negley reports 215 cases, with a mortality rate varying from 11 per cent, in those in which operation was performed within the first twelve hours, up to 52.3 per cent, in those in which operation was performed after twelve hours.

After checking the analysis of nearly 1,000 cases, Brooks considered his case unique in that the patient was the youngest to recover from ruptured bladder. He found records of a patient 2½ years old reported by Huff and of 3 patients 3 years old reported by other authors. In 1918, an article by Angevine reported a case of fractured pelvis with rupture of the bladder in an infant less than 2 years old who recovered.

The mortality rate is much higher than for rupture of a peptic ulcer if operation is performed within twelve hours, but after twelve hours the rate rises much more rapidly in cases of ulcer. The seriousness of ruptured urinary bladder has not been stressed in textbooks. The average physician does not realize the seriousness of the condition. The etiologic factor in rupture of bladder may be of the following types: trauma when the bladder is more or less distended with urine; an accident with a full bladder; penetrating wounds, such as a gunshot, stab and shrapnel; fractured pelvis, or any violent blow or fall. Predisposing factors are intoxication, hypertrophied prostate, pregnancy, stricture of urethra or any other condition that may interfere with urination. Symptoms of intraperitoneal rupture of the urinary bladder are similar to those of rupture of intestines or of any hollow viscus such as the stomach, within the abdomen. The most important point in the diagnosis is a history of not having voided since the accident. This point led to the diagnosis in Brooks' case. It is unwise to wait long for a patient to void, because if there is much shock there will be little urinary secretion while the patient is in shock. Every hour lost before operation counts in the mortality rate. Diagnostic points are (1) a history of accident, (2) inability of the patient to void and (3) pain low in the abdomen and rigidity. Diagnostic aids are (1) roentgenologic examination to determine whether the pelvis is fractured; (2) injection of sterile opaque solution into the bladder and (3) injection of air into the bladder and roentgenologic examination of the patient in the upright position.

24. Brooks, R. E.: Traumatic Rupture of Urinary Bladder in an Infant Three and One Half Months Old with Recovery, J. Urol. **55**:363-365 (April) 1946.

The patient, aged 3 months, had been in an automobile wreck the previous night (about eighteen hours earlier) and had not voided since. The child was in shock and was crying as if in severe pain. The abdomen was rigid and distended. Catheterization yielded no urine. The roentgenogram did not reveal fracture of the pelvis or any other bones but showed a tremendous amount of gas in the intestinal tract. Brooks injected 20 cc. of diodrast into the bladder. The solution was immediately disseminated throughout the abdominal cavity.

The diagnosis of ruptured bladder was made, and transfusion of 150 cc. of citrated blood in the jugular vein was given at once. The patient was prepared for operation, which was performed twenty hours after the accident.

An incision was made low in the midline. The peritoneum was opened and much urine aspirated from the abdominal cavity. There was a rent 5 cm. long in the dome of the bladder. Brooks closed the peritoneum and placed a no. 16 Foley catheter in the bladder and a small piece of rubber drain in the space of Retzius. A small catheter was placed in the urethra for drainage. The patient began taking nourishment the next day. The tube and catheter were removed on the sixth day, and the patient began voiding within a few hours.

Foreign Body.—Bors and Bowie [25] discuss the migration of foreign bodies and report a case of migration of a shell fragment into the bladder. A 23 year old white soldier was wounded by hand grenade. The shell fragment hit him in the right thigh, causing a compound comminuted fracture of the right femur in the middle third. Stereoscopic roentgenograms revealed a metallic foreign body in the pelvis, well outside the outline of the bladder. Later the patient had slight hematuria. About a week later he noticed slight burning on micturition, terminal dysuria and frequency. Symptoms increased but did not become severe. A splinter could be felt just under the skin left of the radix penis. Roentgenologic examination revealed a metallic foreign body surrounded by several concentric layers of calcium in the region of the bladder. This diagnosis of calculus in the bladder was confirmed by cystoscopy. The calculus containing the metal splinter was removed by suprapubic approach. Spinal anesthesia was used.

The important feature in migration of a foreign body is the free interval between injury and the first onset of urinary symptoms which indicate involvement of the bladder. It is likely that the end of the free interval marks the onset of penetration. The interval in this case was about five months. This corresponds to the reports on the migration

25. Bors, E., and Bowie, C. F.: Migration of Foreign Bodies with Report of Case of Migration of a Shell Fragment into the Bladder, J. Urol. **55**:358-362 (April) 1946.

of pegs or pins used for the repair of fractures of the hip joint, whereas in a case of bullet penetration the interval was five years.

SCROTUM AND TESTICLE

Trauma.—Swersie [26] presents 2 cases of uniform simultaneous swelling of the testicle and epididymis on the left side following blast injury. It is suggested that this type of injury may produce tension about the external inguinal ring, which in turn impedes circulatory return from the scrotum. This condition probably is diagnosed epididymitis or epididymo-orchitis without due consideration of the cause. The term "blast scrotum" would seem more appropriate.

Tumors.—Lowry, Beard, Hewit and Barner [27] give an analysis of 100 cases of tumor of the testicle. They state that this is a disease of early adult life and that many cases of the condition have been seen in the military service. Treatment in 100 cases of teratoma of the testicle was in general by the same method, that is, by orchiectomy followed by deep roentgen therapy. It is believed that this group of cases, with proper subsequent follow-up, will serve to test the efficacy of this method of treatment. Tumors of the testicle comprise approximately 4 per cent of all malignant lesions of the genitourinary system in civilian hospitals. In an Army general hospital, where a great majority of the patients are between 20 and 40 years of age, the disease is seen with greater frequency. In the first 27,000 admissions to this Army general hospital 100 cases were observed. Teratoma of the testicle represented approximately 70 per cent of all neoplasms of the genitourinary system and 7.86 per cent of all malignant tumors.

For many years there has been diversified opinion regarding the classification of teratoma of the testicle. The classification employed by the majority of urologists is that suggested by Ewing, based on the microscopic appearance or cell type of the tumor. Malignant tumors of the testicle are considered to arise from a cell which is capable of producing tissue resembling that arising from any or all three germinal layers.

Since adult teratomas are derived from a cell capable of producing any tissue originating from the three germinal layers, they contain adult rudimentary organs. Cartilage, muscle tissue, glandular tissue, hair follicles, fibrous tissue and bone are found in that order of frequency. These tumors must always be considered malignant even though malignant tissue is not found after careful search.

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26. Swersie, A. K.: Unilateral Scrotal Swelling Following Blast Injury: A Syndrome, J. Urol. **55**:292-294 (March) 1946.

27. Lowry, E. C.; Beard, D. E.; Hewit, L. W., and Barner, J. L.: Tumor of the Testicle: Analysis of One Hundred Cases; a Preliminary Report, J. Urol. **55**:373-384 (April) 1946.

Mixed type teratomas are similar to adult teratomas but contain malignant tissue in the form of embryonal carcinoma, seminoma or adenocarcinoma. By far the commonest testicular malignant lesion is embryonal carcinoma. Microscopically the tumor consists of a uniform large, round, polyhedral cell with an abundant clear cytoplasm. Seminomas are usually of the single cell type but were noted in mixed tumors in this series of cases on two occasions. Microscopically the tumor is little different from embryonal carcinoma. Adenocarcinomas are composed of a homogeneous cellular structure having a tendency toward formation of alveoli. In some of these tumors of apparently a single cell type careful search of many sections will sometimes reveal adult elements, but in many instances no such adult tissue can be found.

The chief complaint in 86 per cent of the cases reported herein was "painless swelling of the testicle," which in most cases was accompanied with other symptoms referable thereto, such as heaviness in the scrotum and the mechanical interference of the enlarged testicle during exercise. Six patients in this series complained of pain in the affected testicle, the pain varying from dull ache to sharp incapacitating pain. These cases were all of the type with a history of sudden enlargement of the testicle within a few days prior to the onset of pain. The diagnosis of teratoma of the testicle can, with few exceptions, be made with accuracy by physical examination. The enlarged testicle invariably maintains the configuration of the normal testis, no matter what size it attains. The tumor is usually of uniform consistency and is firm and rubbery. The affected organ is stony hard, chiefly in the adult type of tumor. The successful management of teratoma of the testicle depends mainly on early diagnosis. The average interval in these cases between the first symptoms noticed by the patient and operation was ten months.

Malignant lesion of the testicle may be confused with epididymitis, orchitis, hydrocele, hematocele, torsion of the cord, tuberculosis and syphilis of the testicle. Acute epididymitis, torsion of the cord, hematocele and orchitis are associated with severe pain and testicular tenderness and occasionally with fever and leukocytosis. Tuberculosis is associated with pyuria and induration of the prostate and vesicles. Tuberculosis is practically never primary in the testicle, and a focus can usually be found in the lung or elsewhere in the urinary tract. Hydrocele is a fluctuant tumor which transilluminates light except in the chronic thick wall type. Hydrocele, both acute and long standing, is an elongated tumor, and almost never is the normal contour of the testicle preserved. Syphilis of the testicle produces a hard, irregular, painless tumor, which, associated with a history of a primary lesion and a positive serologic reaction of the blood, leads to the correct diagnosis. Hematocele is painful in the acute phase, and a history of trauma usually can be elicited. The quantitative analysis of the urine for prolan A has

proved to be a valuable adjunct in the diagnosis of these tumors in some clinics. Not only is the diagnosis made, but the type of tumor is said to be predicted with a fair degree of accuracy.

Metastasis from teratoma of the testicle is prone to occur early and is, with rare exceptions, by way of the lymphatic vessels. The lymphatic drainage of the testis is almost entirely to the periaortic nodes. The main lymphatic channels accompany the spermatic vessels from the testicle through the cord as far as the level where the vessels cross the ureter, and from here they lead directly to the periaortic nodes from the level of the bifurcation of the aorta to the celiac axis at a region near the renal pedicles. In this series of cases, metastasis was found to have occurred in 32 cases, invariably by way of the lymphatic vessels with the exception of 1 case, in which the patient died when the vena cava was invaded by direct extension of metastatic lesions along its course. The patient died of pulmonary embolus.

In this group of 100 cases treatment in general was by the same method, that is, after the method described by Dodson, in which the testicle was removed after ligation of the spermatic cord at the level of the internal inguinal ring. An incision is made parallel to the inguinal canal on the affected side, 6 to 10 cm. in length, depending on the size of the affected testicle. The incision is not extended into the scrotum, and the external oblique muscle is divided in the line of its fibers for an equal distance. The spermatic cord thus exposed is ligated at the level of the internal inguinal ring before the testicle is disturbed. The testicle is then, by gentle traction, delivered into the wound and removed. In this series of cases a more radical orchiectomy, with dissection of the lymph glands on the affected side, was not performed. Since in many cases metastasis to the opposite side had occurred, lymphatic dissection on the affected side is not considered a curative procedure.

Roentgen therapy is generally started as soon as the patient can be comfortably transported to that department (as a rule, three to five days after operation).

The results of the treatment in this series of cases to date have been somewhat discouraging. Twenty-four patients on admission had definitely demonstrable evidence of metastasis, and in 2 other cases metastasis occurred while the patients were in the hospital. Subsequent examination reveals that 12 additional patients now have demonstrable evidence of metastasis. When roentgen therapy was administered when metastasis had occurred, in only a few cases did the size diminish appreciably or the metastatic mass disappear. When an initial response was obtained the growth subsequently recurred. In several cases definite advancement of the disease was noted during the course of the treatment. Fourteen of the patients are now dead; an additional 8 are bedridden and are dying from the disease. Sixty-eight of the 100 patients

are now living and well and are at the time of this report without evidence of metastasis. The length of time that has elapsed since operation in these cases varies from a few weeks to three years. All these patients were treated as previously indicated by orchiectomy and roentgen therapy.

Barringer [28] discusses the prognosis in teratoma testis. Early simple orchiectomy is necessary to provide a pathologic diagnosis. With the exception of the rare cases in which an extremely high output of prolan B indicates the presence of chorioma, there is absolutely no sure method of making a preoperative diagnosis. It does not seem to matter, so far as the final outcome is concerned, whether the testicle is removed immediately or some weeks after irradiation.

Barringer has reviewed the pathologic material obtained at operation. There were 69 cases in all. Of these there were 55 cases of seminoma (80 per cent) and 12 cases of adenocarcinoma (17 per cent). In 31 of the 55 cases of seminoma (56 per cent) the patients were well for five years or more, and in 9 of these 31 (29 per cent) metastasis had occurred. Of the 12 patients who had adenocarcinoma 10 (83 per cent) were well for five years. Four of the ten adenocarcinomas (40 per cent) had metastasized. These figures emphasize that surprisingly few patients with metastasizing seminoma survive, whereas a relatively high percentage with metastasizing adenocarcinoma survive for more than five years.

The lymphatic vessels of the cord are not often invaded by the testicular tumor. If metastasis occurs by way of the lymph channels, generally the channels do not become involved but the glands beyond do. If there is direct invasion of the lymph channels, this is shown by the pathologic examination of the cord in the removed testicle or by teratomatous growth at the site of the stump of the cord occurring sometimes after the operation. If the lymphatic vessels of the cord are involved, the prognosis is much graver. The most important parts of the physical examination are examination of the abdomen for masses and of the left supraclavicular region for involvement of a single node. A roentgenogram of the thorax may reveal evidence of metastasis to the lung. One examination rarely done (and it is strange that trained urologists should neglect this) is rectal examination. In a few cases, perhaps 1 per cent, the periprostatic lymphatic vessels are the site of massive metastasis. If such metastasis is present, the prognosis is naturally graver.

The site of involvement of regional nodes in 37 cases in which necropsy was performed was as follows: inguinal, 4 cases (10.8 per

28. Barringer, B. S.: Prognosis in Teratoma Testis, Tr. Am. A. Genito-Urin. Surgeons **37**:197-206, 1944.

cent); pelvic and iliac, 14 cases (37.9 per cent); lumbar, 20 cases (54.16 per cent); celiac, 21 cases (56.87 per cent); mesenteric, 7 cases (18.95 per cent); mediastinal, 18 cases (48.7 per cent); bronchial, 13 cases (35.2 per cent), and cervical, 13 cases (35.2 per cent).

A tumor of the testicle rarely metastasizes to the inguinal nodes unless it has perforated the tunica vaginalis or capsule of the testicle. In several cases enlargement of these nodes appeared after operation. Barringer states the belief that involvement of the inguinal nodes may be the result of cutting into the teratoma, with the resultant implanting of tumor cells in the operative wound and a secondary involvement of the inguinal glands. The skeleton was involved in 4 cases (10.8 per cent).

Appendical Torsion.—Vermeulen and Hagerty [29] report 2 cases of torsion of the appendix testis (hydatid of Morgagni). They state that unless it is realized that the severity of symptoms produced by torsion of this minute structure may be out of all proportion to the size of the appendix testis, it may easily be mistaken for other intrascrotal diseases, such as acute epididymitis, acute orchitis or torsion of the spermatic cord. In other instances a diagnostic mistake may be made because the initial symptoms sometimes focus attention on the lower part of the abdomen and little is present to indicate that the lesion is inside the scrotum. In general, however, the symptoms are those of torsion of the testis.

Vermeulen and Hagerty made a study of the anatomy of the appendix testis and state that grossly it is a small ovoid or flattened tab of pale gelatinous tissue, varying from 1 mm. to 1.0 cm. in diameter. It is attached to the tunica albuginea by a short pedicle. In at least half of the specimens examined, the pedicle was sufficiently long and narrow so that it could have undergone torsion.

Microscopically the appendix testis is made up of loosely arranged connective tissue moderately rich in blood vessels. In the connective tissue of some specimens were seen spaces of varying size apparently lined with endothelium and frequently containing precipitated albuminous material. These structures had more the appearance of lymph channels than of the remnants of epithelium-lined tubules. All the appendixes testes were covered by tall columnar epithelium, which was sometimes ciliated. This epithelium became continuous with the flat columnar epithelium of the tunica albuginea. The epithelial covering of the appendix testis and the lining of the epithelial inclusions closely resembled the lining of the distal end of the fallopian tube of the female. This would be expected, because the appendix testis is derived from the cranial end of the müllerian duct, which in the female forms the fimbriated end of the fallopian tube.

29. Vermeulen, C. W., and Hagerty, C. S.: Torsion of the Appendix Testis (Hydatid of Morgagni): Report of Two Cases with a Study of the Microscopic Anatomy, J. Urol. **54**:459-465 (Nov.) 1945.

Orchitis.—Burhans [30] discusses the inflammation of the testicle in mumps and states that it is not primarily orchitis but an acute hydrocele around the testicle, which causes strangulation of the testicle, in contradistinction to a slow-forming hydrocele. This acute process causes strangulation, acute inflammatory edema and ultimate fibrosis and atrophy of the testes. If a small scrotal incision is made during the acute orchitis, acute hydrocele is encountered. The fluid in the tunica vaginalis is under extreme pressure and has a viscid yellowish color. If drainage is accomplished at this time, no further therapeutic measure is needed and the temperature curve simulates that in crisis of pneumonia. If drainage is delayed until acute swelling and fever have developed, the acute tension and pressure of the hydrocele are not present and the testicle is blackish in appearance. On incision of the capsule or tunica propria and tunica albuginea, the testicular tissue presents an appearance of bulbous edema and inflammation. Burhans suggests incision and drainage of the acute hydrocele in early cases, with removal of the drain in forty-eight hours. In late cases incision of the tunica vaginalis and incision and drainage of the tunica propria and tunica albuginea should be employed. General anesthesia induced with pentothal sodium is the anesthetic of choice.

URETHRA

Lintgen and Herbut,[31] in a clinicopathologic study, sectioned and studied 100 female urethras and the urethras of 16 newly born full term or premature male infants. Measurements were taken of the prostatic urethras of 40 men. None of the female urethras studied showed evidence of obstruction. Glands were found in every case in the anterior part of the female urethra and in 65 per cent of the posterior part of the female urethras. Seventy-six of the 100 female urethras showed inflammatory reaction histologically. The cause or causes of the inflammation were not apparent. Posterior urethral glands, previous catheterization or cervical inflammation did not appear to be a contributing factor.

Diverticula.—Herman and Greene [32] state that despite attention which has been paid to urethral diverticulum in the female the origin of the condition remains obscure. The average age of patients is about 40 years. The majority are married and have borne one child or more. The condition is relatively commoner among Negro women, probably owing to the greater frequency and neglect of urethral infections and

30. Burhans, R. A.: Treatment of Orchitis of Mumps, J. Urol. **54**:547-548 (Dec.) 1945.

31. Lintgen, C., and Herbut, P. A.: A Clinicopathological Study of One Hundred Female Urethras, J. Urol. **55**:298-305 (March) 1946.

32. Herman, L., and Greene, L. B.: Diverticulum of the Female Urethra, Tr. Am. A. Genito-Urin. Surgeons **37**:297-311, 1944.

poor obstetric care. Calculi occur in association with diverticula in 17 per cent of cases, the majority developing in situ from urinary crystals. Ammonium phosphate is the commonest constituent of such stones. Migratory urinary calculi rarely find their way into diverticula and grow by accretions. Like foreign bodies they may become impacted behind urethral strictures, causing periurethral abscesses, the resulting cavities being classified as diverticula. Among the 63 cases in this report, 4 were complicated by two or more stones and 7 by single stones. A most unusual case in which thirteen ammonium phosphate stones were fitted together to form a mass the size of an orange is described.

Urethral diverticula in the female may be silent or give rise to most insignificant symptoms. This is true especially when the sac is small and uncomplicated, provided with a large opening and situated beneath the anterior third of the urethra. On the other hand, the symptoms may be severe. In most cases mild vesical irritation with dysuria, frequency and urgency of urination results. Obstructive symptoms, including urinary difficulty, acute and chronic retention, dribbling and true or paradoxic incontinence are rather rare and more likely to occur when the sac is large and springs from the deep segment of the urethra; they are rarely due to associated urethral stricturing. The symptom directly referable to uncomplicated diverticulum is a painless lump in the vagina, which the patient may have discovered accidentally and, in rare instances, may have noticed that it increased in size during urination and reduced in size thereafter or that it could be emptied by pressure. The inflammation of the sac is likely to be associated with pain in the urethra, pain on urination and during coitus, soreness in the vagina on sitting or walking and, in some instances, purulent urethral discharge. Spontaneous urethral hemorrhages may originate from ulceration or a complicating neoplasm originating from the sac wall. Referred symptoms comprise rectal irritation and pain referred to the pelvis, lumbar region, back and along the course of either ureter.

Diverticula of the urethra are often overlooked either (1) because suggestive symptoms and signs are wanting, (2) because certain complicating lesions such as urethritis give rise to many of the symptoms commonly occurring in association with diverticula or (3) because examination fails to disclose the condition. The diagnosis is simple enough in cases in which a suburethral mass is found that empties on pressure with the discharge from the urethra of mucoid, purulent or bloody fluid. However, the sac may be collapsed at the time of examination and therefore impalpable or, if distended, may fail to empty

because the orifice is occluded or the sac filled with a neoplasm or thick, mucopurulent secretion.

The majority of diverticula are about the size of an English walnut and attached to the floor of the middle third of the urethra. Their size varies from that of a pea to that of an orange and may empty into the urethra at any level. The anterior third of the canal is rarely involved, while comparatively few diverticula empty into the proximal segment. In the latter event the sac may burrow beneath the sphincteric and trigonal areas, rendering operation more serious and difficult. In 1 case, the sac encircled the urethra. Acute inflammation of the sac and surrounding tissues may lead to closure of the orifice and preclude instrumental studies, in which event the lesion may be diagnosed as simple abscess and treated by incision and drainage.

Roentgenography, urethroscopy and urethrography are employed not only to assist in and to confirm diagnosis of diverticulum but to determine the size and location of the orifice or orifices, the size, location and form of the sac, whether it is unilocular or multilocular and whether it is smooth walled or with filling defects suggestive of neoplasm.

Satisfactory visualization of the orifice of a diverticulum, which may be small and, whatever the size, obscured by redundant folds of mucous membrane, is best accomplished by employment of a direct vision water-dilating urethroscope, which permits inspection of the entire circumference of the distended urethra at all levels. Herman and Greene find oblique, indirect and right angle telescopes unsatisfactory for this purpose. The orifice is usually round and smooth and often situated slightly lateral to the midline, but it may be linear and irregular. In some cases there are two or more small openings, the involved area presenting a cribriform appearance. Roentgenologic visualization of a soft shadowgraph catheter or opaque medium introduced into the cavity is a useful diagnostic measure but less so than cystourethrography.

With few exceptions diverticula should be removed through the vagina. This comprises (1) introduction of a Foley catheter; (2) exposure of sac through an adequate incision in the vaginal wall; (3) mobilization of the sac to the area of its urethral attachment; (4) excision of the sac close to the urethra; (5) careful closure of the linear defect in the urethral floor, care being taken to include in the sutures a narrow margin of the urethral wall on either side, the defect being closed in the long axis of the urethra (inversion of the tissue is to be avoided); (6) if possible, the bringing together of the separated layers of vaginal fascia independent of the vaginal mucosa as a means of providing maximum support, and (7) the trimming of one vaginal flap so that when brought together the suture lines will not be superimposed.

Fine chromic surgical gut is used. A small rubber drain is introduced to the level of the urethral repair and the vagina packed lightly with gauze coated with sulfathiazole ointment. Cystostomy is unnecessary; catheter drainage is maintained for a week or more. Sulfonamide drugs are given in small dosage during the period of convalescence.

In discussing Herman and Greene's paper O'Conor [33] states that he has operated on 9 patients with urethral diverticula during the past twenty years. O'Conor emphasizes the importance of outlining the size and shape and position of the diverticular sac. It is helpful in the operative plan of approach to know the exact location of the neck of the diverticulum. If the neck is subtrigonal, one must do a much more elaborate dissection of the urethral and vesical space.

O'Conor demonstrated that when it is impossible by any means, either instrumental or by urethral injection, to outline the sac, one may get a filling outline either by injection of air into the urethra or by filling the bladder with a solution of sodium iodide and having the patient void several times and then taking a roentgenologic picture. In 2 of these instances in which he could not find the orifice by inspection and no fluid entered the sac, patients filled the sac during voiding, so that he was able to get a good outline of the diverticulum two to four hours after the cystogram was made. In the third instance even this procedure did not help, so he tried injecting air into the urethral catheter, which showed a contrast outline of a large biloculated diverticulum well anterior to the internal vesical sphincter.

O'Conor expresses the opinion that it is important, in preparing these patients for operation when they have symptoms of systemic absorption with fever, leukocytosis and infected urine, to keep the diverticulum empty for a few days or perhaps a week; then, by administration of urinary antiseptics the local inflammatory reaction is greatly reduced. He has done this in 4 cases recently by emptying the diverticulum digitally, introducing a small female Foley catheter for drainage of the bladder and then packing the vagina rather loosely with gauze so that the under surface of the urethra is compressed in such a manner that the diverticulum is kept empty. Then by the giving of sulfonamide drugs the local condition is much more favorable for resection of the diverticulum than if operation were performed without reduction of the local inflammatory reaction.

Duplication.—O'Heeron and Webster [34] report 2 cases of duplication of the urethra. In both instances the patients sought medical treatment

33. O'Conor, V. J., in discussion on Herman and Greene,[32] pp. 313-314.

34. O'Heeron, M. K., and Webster, F. A.: Report of Two Cases of Double Urethra in the Male, J. Urol. **55**:391-396 (April) 1946.

because of the presence of a discharge from the accessory urethra and dysuria. In case 1 the condition was treated by total excision of the accessory urethra, and the result was satisfactory. In case 2 the septum between the two urethras was incised, and the result was unsatisfactory because of the loss of the nozzle effect of the urethral meatus.

URACHUS

Anomaly.—Simon and Brandeberry [35] present a case of congenital urinary umbilicocystic fistula. The embryologic abnormality was nonformation of the urachus, and the result was a persistent fetal bladder. This is the most frequent anomaly of the urachus and the usual cause of congenital umbilical urinary fistula.

The closure of this type of defect is often spontaneous or, at most in uncomplicated cases, is a simple surgical problem, and the mortality rate is low. In this instance, however, the presence of renal insufficiency due to other congenital anomalies of the urinary system was suspected, and operation was deferred. Necropsy findings confirmed the presence of these conditions. The frequency with which congenital urinary umbilicocystic fistula and other anomalies of the urinary system coexist cannot be definitely established, because death is unusual and necropsy findings are rarely available. However, anomalies in this system are typically multiple, and the possibility of their coexistence should always be suspected and ruled out before radical operation is considered.

RENAL HYPERTENSION

Kittredge and Brown [36] state that the etiologic basis for unilateral renal hypertension is still speculative, although research indicates that it may be explained on the basis of a humoral mechanism originating within an ischemic kidney. The incidence of hypertension, as encountered in unilateral renal disease, is no higher than the incidence in a control group of comparable age taken at random. Unless the cause of hypertension is otherwise explained, all hypertensive patients should have a complete urologic study to find whether unilateral renal disease is present. This study should include a carefully taken urologic history, urinalysis, tests of renal function and urologic roentgenograms Of the patients who require nephrectomy for well established unilateral renal disease, only a small percentage can expect relief from any coexisting

35. Simon, H. E., and Brandeberry, N. A.: Anomalies of the Urachus: Persistent Fetal Bladder, J. Urol. **55**:401-408 (April) 1946.

36. Kittredge, W. E., and Brown, H. G.: The Present Status of Unilateral Renal Hypertension, J. Urol. **55**:213-219 (March) 1946.

hypertension. The possibility of cure in a given case is influenced to a great extent by the duration of the hypertension, inasmuch as in chronic hypertension irreversible vascular changes may have occurred in the opposite kidney which will prevent a return of the blood pressure to normal.

There is accumulating considerable clinical evidence which will aid in evaluation of nephrectomy for the treatment of hypertension associated with various unilateral lesions of the genitourinary tract. Unilateral atrophic pyelonephritis apparently offers the most promise of cure by that means. Patients who have tuberculosis, renal neoplasm and renal calculi with infection also may be benefited by this operation.

A careful evaluation of changes in blood pressure following nephrectomy is essential. No patient should be considered cured until he has been followed up for at least a year, since postoperative rest in bed and removal of toxic irritants contained within such diseased kidneys can cause a temporary fall in blood pressure.

URINARY INFECTION

Proteus infections in general and those of the urinary system in particular are discussed by Stul,[37] based on his experience with treatment in 22 cases. Proteus infection of the urinary system is rare. The pathogenesis, which corresponds to that of colibacillary infection, is not discussed. Mixed infections of Escherichia coli and the coccal groups occur at least as commonly as those caused solely by Proteus vulgaris. Cystitis and pyelitis with secondary formation of concretions and postoperative infections of the bladder and kidneys occur more frequently than proteus cystitis and proteus pyelitis.

In some cases proteus infection is only a harmless postoperative complication; usually, however, it is a severe disease. Less often it leads to the loss of a kidney, and it may even result in death of the patient. The disease is generally tenacious and resists therapy. The best results are obtained by surgical intervention (removal of calculi or nephrectomy) if this is possible. The usual urinary disinfectants, lavages and chemotherapy rarely affect the infection. Vaccine therapy is often efficacious. Cicatrization in simple or postoperative infection may be extensive. Toxic symptoms are common and may be severe.

Strain[38] reports that trichomonas infection in males is commoner than is generally realized. A freshly voided warm specimen must be examined before the diagnosis can be excluded. A specimen which

37. Stul, T.: Die Harnwegsinfektion mit Bact. Proteus Hauser, Helvet. chir. acta **12**:638-657 (Dec.) 1945.

38. Strain, R. E.: Trichomonas in the Male, J. Urol. **54**:483-485 (Nov.) 1945.

has stood for a short time is not satisfactory. In 3 cases in which the patients were boys less than 6 years of age no pus cells were noted in the urine. When treatment with calcium mandelate was given symptoms were relieved and trichomonas disappeared. Treatment in cases in which secondary infection has taken place is less successful, probably because of failure of contact of the medication with the trichomonas. In such cases it should be suspected that trichomonas are being harbored in small abscesses of the prostate, and drainage of these abscesses will be necessary for cure.

TREATMENT

Irmisch,[39] in a study of penicillin therapy for sulfonamide-resistant gonorrhea, found that in 200 (41.4 per cent) of 483 cases of gonorrhea smears and cultures were sterile after administration of one of the sulfonamide drugs for five days. In 283 cases (58.6 per cent) the disease was resistant to the sulfonamide treatment received during the prescribed five day course. In 271 cases, or 95.8 per cent, of the 283 cases of sulfonamide-resistant gonorrhea, smears became sterile after 100,000 units of penicillin had been administered as described. In the 12 remaining cases the condition responded to administration of additional penicillin and resulted in an over-all rate of cure of 100 per cent. The lignin test is described, since it is thought to be of value in the detection of concealed sulfonamide therapy.

Allemann and Kriwaczek [40] report 600 cases of subacute and chronic infections of the urinary tract, treated with silver chloride Metem 4 per cent, a Swiss preparation. Eighty-five per cent of the patients recovered after short periods of treatment. There were no cures obtained when residual urine was present if the infection was tuberculous.

Exley [41] states that penicillin has a definite value in the treatment of pyogenic cocci in the urinary tract. With few exceptions, organisms unable to inactivate penicillin were susceptible to its action, if free urinary drainage was present and anatomic abnormalities were previously eliminated. Ample doses should be given to prevent development of resistant strains by the organism. The successful treatment of staphylococcic infections requires twice the dose necessary for treatment of streptococcic

39. Irmisch, G. W.: Penicillin Therapy for Sulfonamide Resistant Gonorrhea, J. Urol. **55**:306-308 (March) 1946.

40. Allemann, R., and Kriwaczek, E.: Die Behandlung infektiöser Erkrankungen der Harnwege mit Silber Metem extern (Silberchlorid Metem 4%), Schweiz. med. Wchnschr. **76**:9-12 (Jan. 5) 1946.

41. Exley, M.: Penicillin Treatment of Urinary Infections Caused by Pyogenic Cocci: A Report of One Hundred and One Cases, J. Urol. **55**:435-439 (April) 1946.

infections. Exley's best results were obtained with a daily dose of from 200,000 to 350,000 Oxford units for from three to six days. The local use of penicillin was found to be an excellent adjuvant in postoperative treatment in 3 cases.

REITER'S DISEASE

Sargent [42] discusses Reiter's syndrome and presents 3 cases in which the urologic aspect of the typical symptomatic triad of arthritis, conjunctivitis and urethritis was striking and the urethritis had extended until severe cystitis was present. The cause of the disease is unknown, and no treatment which materially affects the course of the disease has been found. Sargent suggests the term "idiopathic blennorrheal arthritis."

42. Sargent, J. C.: Reiter's Syndrome, J. Urol. **54**:556-564 (Dec.) 1945.